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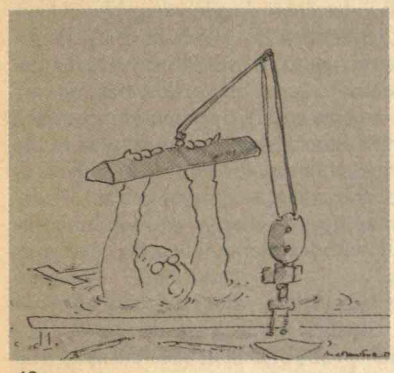

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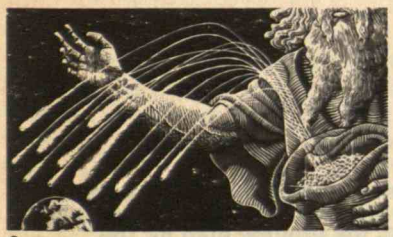

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Liberal Education for the Police Officer-Engineer

Samuel Florman calls for a more humanistic education for engineers in "Technological Literacy: An Uneasy Victory" (*July, page 6*). But truly professional engineers are those who place public welfare above their own or their employers'. The problem is that those who do so will find it difficult if not impossible to survive.

For example, General Motors engineers who found the Corvair unstable on curves at any speed turned the information over to Ralph Nader, because they were afraid of being fired and blacklisted if they went public themselves. A.F. Fitzgerald was fired by the Defense Department when he testified about large-scale waste before a U.S. Senate subcommittee.

We need a mechanism for protecting engineers who act in the interest of the public, not a better educational system.
Samuel Schiffer
Los Angeles, Calif.

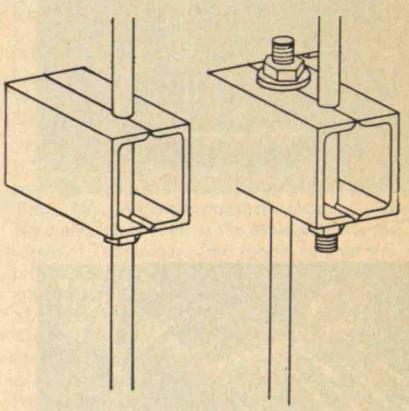
Mr. Florman responds:
I believe that liberal education can enrich the lives of individual engineers, elevate the standards of the engineering profession, and thus benefit society as a whole. The humanities do not devote much attention to the specific issue of whistle-blowing, but I do not agree that more whistle-blowing is needed. Instead, we should seek thoughtful, sensible ways of governing ourselves and our technology. Liberal education of engineers can contribute much to the pursuit of such a worthy goal.

Nuts and Bolts

There is an obvious error in description and illustration in Henry Petroski's "The Kansas City Tragedy: There Is Not Always Strength in Numbers" (*August/September, page 29*). The sketch of the original plan, which called for hanging a continuous rod from the ceiling through the walkway beams (*above, left*), shows an impossible condition. One cannot drop a nut over a continuous rod threaded only at the hanger-rod box-beam connection. The rod would have to be continually threaded and would need an interlocking nut.
Kenneth Green
Salem, Mass.

Mr. Petroski responds:
Mr. Green is of course correct in noting the difficulty of placing a nut onto a rod threaded only at the center. This same difficulty, along with other details, was noted in letters to *Engineering News Record* (September 17, 1981) in the wake of the walkway collapse. However, this detail seems to have been in the original design, and its inappropriateness no doubt prompted the design change that led to the ultimate collapse (*below, right*). Yet, as one of those letters so aptly put it, "A detail that begs a change cannot be completely without blame when the change is made."

My suggestion—that had the walkways been constructed as first designed, they would probably still be functioning today—was made in the context of stress analysis alone. I did not mean to suggest that the original one-rod design was practical. As Mr. Green points out, a continuously threaded rod with an interlocking nut assembly would have done the trick, but the sketch did not suggest this or any other sensible way to assemble the support.



The change that caused a failure. As reader Kenneth Green points out, the original plan for the support of Kansas City Hyatt Regency walkway (left) called for what no builder could build. The design change (right) was the wrong solution.

Low-Risk Threat

No one can be sure how long our groundwater has been contaminated ("*Groundwater Contamination: An*

Emerging Threat," July, page 50). The case of the Love Canal area, where waste burial started in the 1920s, suggests that groundwater contamination may have begun many years ago. But the New York Cancer Registry shows no evidence that higher cancer risks are associated with residence near the site in comparison with the entire state outside New York City. Indeed, many examples show that in some situations, the risk of waste burial is acceptably small. There is little, if any justification for forecasting an impending cancer epidemic from contaminated groundwater.

Ernest W. Volkman
Latrobe, Pa.

Simple Simon's Trolley?

It's true that San Diego *did* keep its trolley simple (*Trend of Affairs, July, p. 75*): the cost was $5 billion per mile instead of 3 to 20 times that much spent on a more exotic system. But there is another way of looking at this "success story," as you describe it: the trolley's 12,000 daily riders should be seen in the context of a growing region with upwards of 3.5 million daily person-trips. Furthermore, each rider pays an average of less than $1 for a service that has total operating and capital costs of $3.40 to $4.30 per passenger trip. By those standards, Braniff should be ballyhooed as a tremendous achievement.

Martin Wohl
Boston, Mass.

R&D on R&R

George Keyworth in "The Goal of U.S. Science Policy" (*July, page 8*) wants to convince the scientific community that he and Mr. Reagan have a soft spot for federal support for research and development. Dr. Keyworth points out that despite several budgetary constraints, "Federal expenditures for research and development will increase by almost 11 percent over 1982; within that, basic research will increase by 9 percent." In other words, given bad times, we should be grateful.

Let's not be fooled by numbers. According to the American Association for the Advancement of Science, when the figures for 1982 are translated into constant dollars, the increase in total federal expenditures is a mere 3.9 percent. Nondefense R&D expenditures will *decrease* by 6 per-

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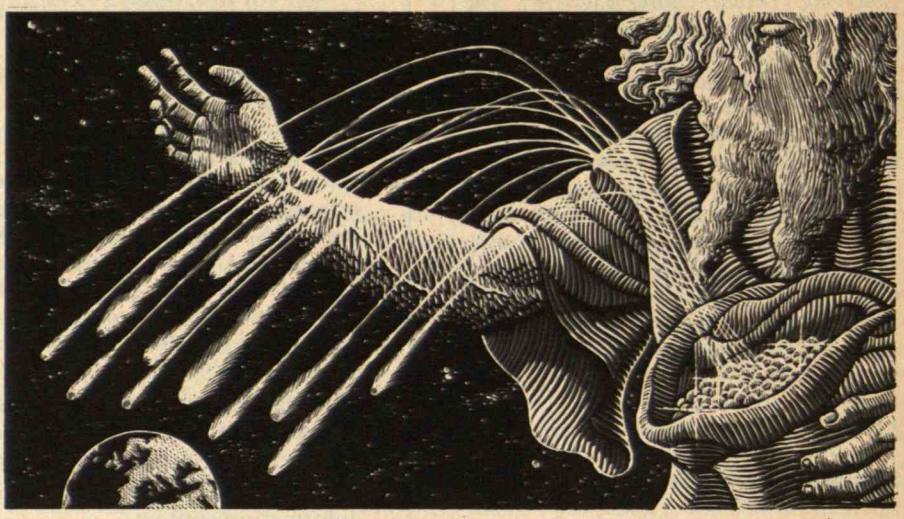
ROBERT COWEN

Kooks, Comets, and Creationism



WHEN Immanuel Velikovsky affronted the scientific establishment a little over three decades ago, it rose in wrath to quash his theories. Although educated as a psychiatrist, he neither expressed himself in the style of a scientist nor had the inbred scientific "taste" that would have deterred him from proposing a patently absurd astronomical scenario. It was easy to portray him as an intellectual booby. But what will the scientific establishment do now that certain key Velikovskian notions have been reincarnated by some of its own members?

Velikovsky proposed that Earth has had violent encounters with cometary bodies in historic times. These, he said, are reflected in ancient myths and literature. Indeed, much of his research was an attempt to find such reflections and assemble them into a coherent picture. Thus, he thought the encounters were the basis for the flood myths of many cultures. He also proposed that a comet carried life forms and seeded Earth with organic materials and living creatures, such as flies. He further proposed that this comet was actually expelled from Jupiter—within historic times—and then became the planet Venus.

There is no way this latter proposal can be reconciled with a considerable body of well-established astronomical knowledge. Therefore, as Victor Clube and Bill Napier of the Royal Observatory in Edinburgh point out, there was little chance that any of Velikovsky's ideas would be taken seriously by scientists. But, they now ask, was Velikovsky really so silly to propose cometary encounters within historical times? Was he so misguided as to look for evidence in ancient writings and myths?

The Edinburgh astronomers answer "no" to both questions. They have developed their own theory in which cometary collisions account for major extinctions in the fossil record. They also propose that comets terrified Earth's peoples in recent millennia, and that at least some of the evidence of this that Velikovsky claimed to find in myths and old literature is very likely valid. The two astronomers have been developing this remarkable thesis for a number of years. They now spell it out for lay people in their book *The Cosmic Serpent* (New York: Universe Books), published this fall in the United States after having been issued earlier in Britain.

ROBERT C. COWEN is science editor of the *Christian Science Monitor* and former president of the National Association of Science Writers.

Comet Seeding and Evolution

While Clube and Napier focus on comet-caused disasters, the scientist who Martin Gardner calls "the greatest maverick among living astronomers"—Sir Fred Hoyle—and his colleague at University College in Cardiff, Wales—Chandra Wickramasinghe—have picked up the notion that comets are bearers of life. Unlike Clube and Napier, they do not cite Velikovsky and might not be flattered to have me link their concept with his. Nevertheless, the parallel is striking. Where Velikovsky had a comet seed Earth with organic matter and flies, Hoyle and Wickramasinghe contend that comets seed Earth with viable genes, bacteria, and, yes, even insects.

Velikovsky linked the action of a comet, which he took to be the nascent Venus, to certain biblical stories that purport to show the hand of God. But Hoyle and Wickramasinghe go him one better—they see the hand of God in the life-seeding action of comets. They say they are forced to conclude that a superior being—they call it a higher intelligence—underlies the creation of life.

These ideas also are spelled out in a book for lay people, released in the United States in late summer after having been published earlier in England. Entitled *Evolution from Space* (New York: Simon and Schuster), the book builds on earlier statements of the developing Hoyle-Wickramasinghe thesis in *Diseases from Space* and *Lifecloud*.

Of the two propositions, that of Clube and Napier is the easier to take from the establishment viewpoint. There is nothing startling in the suggestion that comets can bombard Earth—it is generally accepted that such bombardment was heavy in the planet's early years. Also, scientists think that a cometary fragment probably flattened a Siberian forest near the Tunguska River in 1908. But major impacts are thought to have been very rare for the last several billion years.

Clube and Napier challenge the established view by suggesting that this isn't so. The most widely accepted theory holds that the solar system is accompanied by a cloud of many millions of comets left over from the time of its formation. Comets entering the inner solar system are drawn from this cloud. But Clube and Napier suggest that the comet cloud is repeatedly depleted and replenished as the solar system passes through one of the spiral arms of our galaxy in its orbital motion about the galactic center. They propose that comets form in deep space in interstellar clouds, rather than being left over from the solar system's formation.

As a corollary, they further suggest that there are epochs when the inner solar system receives relatively heavy intrusions of comets. Thus, they link the major biological extinctions with massive cometary impacts. They suggest that a few thousand years ago, the comet Encke, a major body,

(Continued on page 83)

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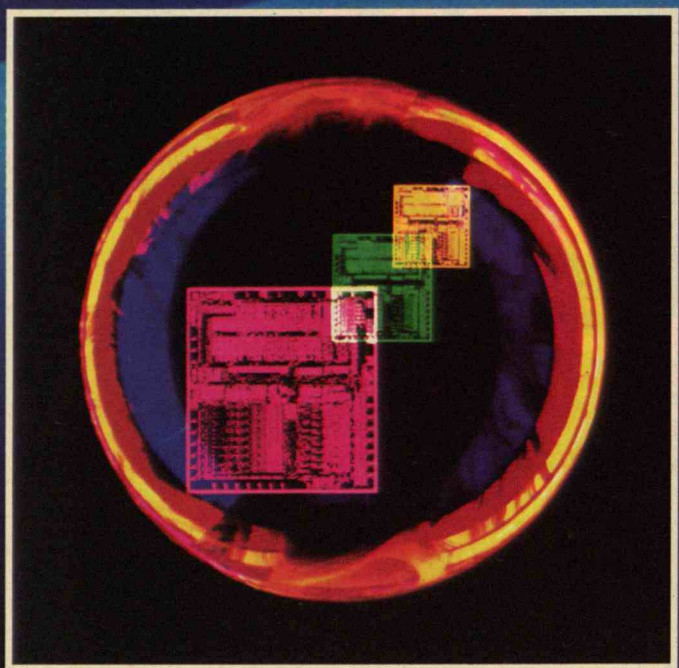

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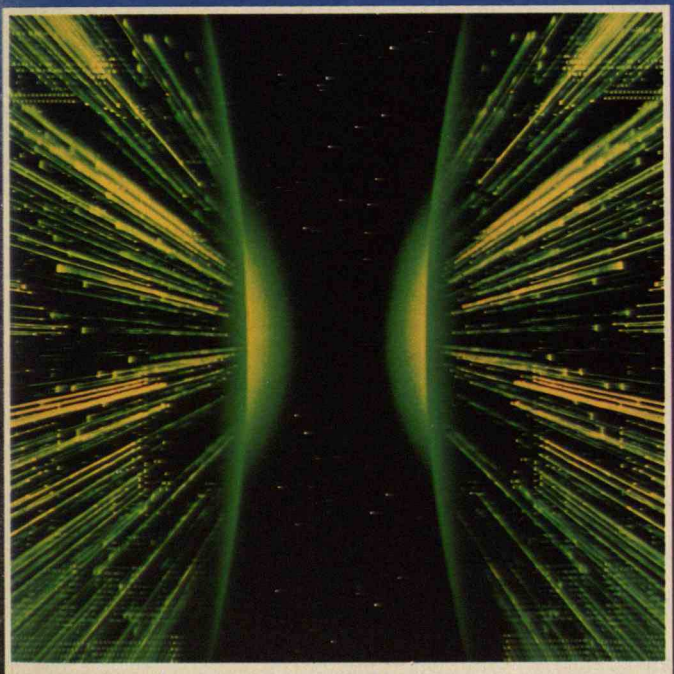

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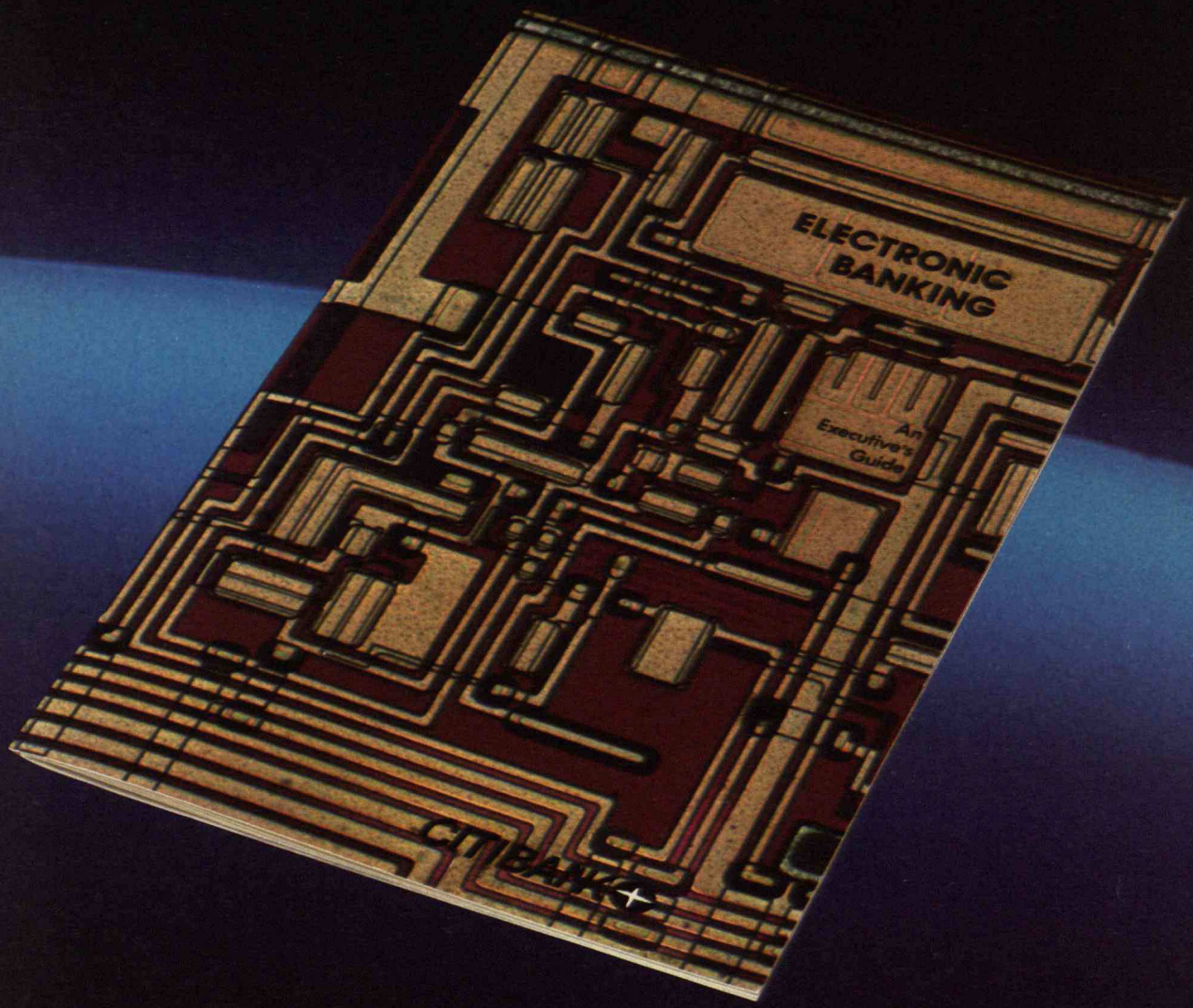

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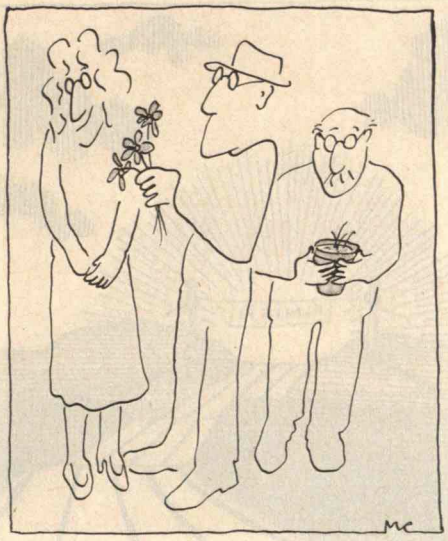
KENNETH BOULDING

Property: Whose Right?

I am spending this year as the Eugene M. Lang Visiting Professor of Social Change at Swarthmore College. Never having been a professor of social change before, even though I have been teaching, preaching, practicing, enjoying, and suffering from social change all my life, I have been thinking about it more than usual. One of my conclusions is that a good deal of social change concerns the definition, distribution, and legitimacy of property.

Social change takes place in three major categories of human relationships, which I call the threat system, the exchange system, and the integrative system. In all these, especially the first two, the concept of property is crucial. The thief redistributes property illegitimately. The bandit uses threat to redistribute property. The Argentines tried, unsuccessfully, to redistribute the political property of the Falkland Islands by threat, and the British, for the moment, have prevented this by counterthreat. Israel took land by threat from the Arabs, and the Arabs have unsuccessfully attempted to get it back by threat. Virtually all law and legislation involves redistribution and redefinition of property, as in zoning laws. All exchanges are mutual transfers of property: unless the parties to an exchange own what they trade, there can be no trade. A grant, whether of a passerby to a beggar, a foundation to a recipient, or a taxpayer to a government, always involves redistribution of property: the net worth (the net value of property) of the donor goes down and that of the recipient goes up.

One of the sources of social change is social strain or pressure. And one of the sources of social strain is the belief that existing definitions and distributions of property are illegitimate, unjust, or can be changed to benefit those who have the power to make such changes. The existing structure and distribution of property is the end result of a long history of conquest, theft, and deceit, but also of thrift, productivity, hard work, and inheritance. Parts of this process may be regarded as legitimate and parts may not be.



My grandfather used to tell a story about a man in his village in the west of England who got into an argument with a local squire as to why the squire possessed the broad acres that he did, whereupon the squire drew himself up and said, "Well, my ancestors fought for it." Whereupon the challenger put up his fists and said, "I'll fight you for it now." The fact that even my grandfather, who had no broad acres of his own, thought the story funny suggests that time makes ancient theft respectable rather than uncouth. It was Pierre Proudhon who remarked that all property is theft, and while this may make a slight shiver go up the spine of the propertied, the answer to this challenge is usually "so what?"

Nevertheless, there is a nagging problem: the suspicion that in the long run, the distribution of property becomes more and more unequal. This creates increasing strain until something blows in war or revolution, unless there are milder ways of relieving the strain.

Revolution is very costly to all parties. It is a thoroughly negative-sum game in which the effort to redistribute property results in its widespread destruction. Permanent revolution is so destructive that nothing is really redistributed. The poor cannot win a class war—there is nothing left to win. Anything above poverty and misery is simply annihilated, as we saw in extreme form in Cambodia. An early attempt to institutionalize revolution may have been the Year of Jubilee of the ancient Hebrews, in which all debts were forgiven every 50 years. No doubt this had catastrophic consequences for the capital market for several years before the Jubilee.

Penalizing the Productive

Progressive taxation is another attempt to make revolution permanent at a milder, less damaging level. Progressive taxation has been modestly successful in what might be called the socialist-capitalist countries, although one worries about the negative-sum aspects of this, too. If the productive rich are taxed excessively, they will not bother to be productive. Whether this is an important effect of the progressive tax system is a matter of some debate. Certainly supply-side economics does not seem to be producing very much supply. One suspects that the progressive inheritence taxes that prevailed in the social democracies, at least until recently, have not affected productivity very much, and could easily have been beneficial. If a person is aiming at a certain goal of wealth, making the goal a little harder to reach may stimulate the effort to achieve it.

I worry more about the subsidy of the unproductive rich by the productive rich. This is implied in the erosion of profit by interest that has occurred for the last ten years or more. Interest is a tax, though not necessarily a progressive tax, on the productive. The productive make profits for the benefit of others, who simply sit back and receive interest. Ironically, political radicals, and even Christian radicals, tend to denounce profit, which is usually a result of productive activity. However, the extremely conservative Moslems denounce interest, sometimes to the point of preventing the development of useful structures in the financial system. The function of the financial system is to enable those who are skilled at using resources productively to take control of these resources away from those who own them but are not skilled in using them. People should have to pay something for this, but it should not be excessive.

In the long run, many of these questions resolve themselves into what is legitimate and what is not. The dynamics of legitimacy dominate all social systems, but we *(Continued on page 83)*

KENNETH E. BOULDING is a project director with the Research Program on Political and Economic Change at the Institute of Behavioral Science, and distinguished professor emeritus of economics at the University of Colorado at Boulder.

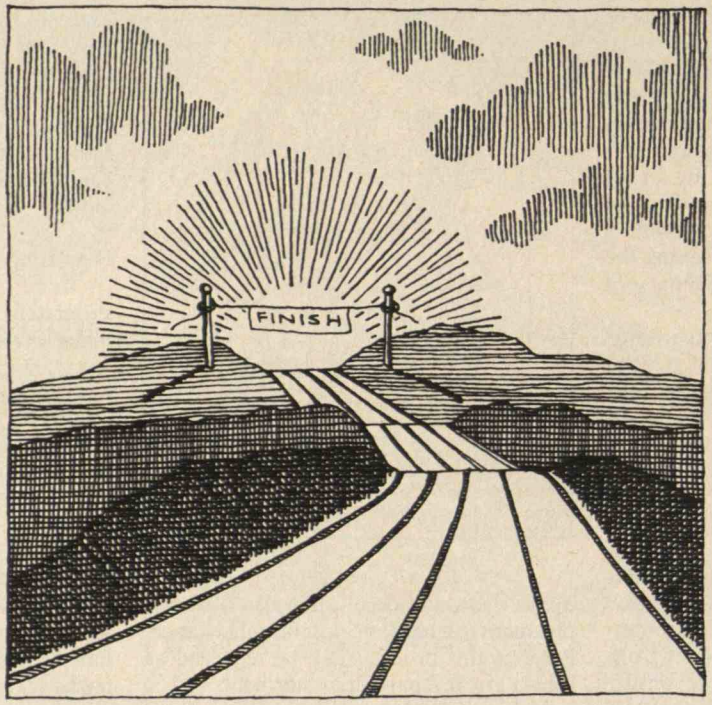
ILLUSTRATION: MICHAEL CRAWFORD

BY RICHARD MUNSON AND BARRETT STAMBLER

Competing for the Sun

ROBERT WILLIS is worried. As president of Solenergy—a small company developing photovoltaic cells, which convert sunlight directly into electricity—he fears that large oil companies are taking over. "Small-business involvement in solar energy development is of critical importance to the nation," he says. "But it is hard to compete with oil giants, which have almost unlimited capital resources."

Steven DiZio doesn't think there is much to worry about. As director of SES, a Shell Oil subsidiary that manufactures solar cells, he believes oil companies have the right outlook for the photovoltaic industry. "An oil company is used to spending $500 million to $1 billion on a refinery and waiting ten years for the first dollar to return," he says. They also have the necessary marketing experience.



What's behind this argument? Willis and DiZio stand on opposite sides in a growing debate about competition in the solar-energy industry.

Willis' concern is based on the fact that over the past few years, the photovoltaic industry has become increasingly "concentrated" and controlled by oil companies. An industry is concentrated, according to Federal Trade Commission (FTC) standards, if four or fewer firms control 40 percent of the market. In the photovoltaic industry, three firms now control 79 percent. Solarex, with 38 percent of the market, is 25 to 40 percent controlled by Amoco; Arco Solar, with 26 percent, is owned by Atlantic Richfield; and Solar Power Corporation, with 15 percent of the market, is owned by Exxon.

But DiZio maintains that oil companies have proved helpful. Their participation lent credibility to the emerging solar-cell industry. And they have reportedly invested more than $70 million in photovoltaic development, some of which went to small firms badly in need of capital.

Costs Still Dropping

Photovoltaics were first used to power U.S. satellites, at a cost of $2,000 per peak watt (a measure of the cell's output at maximum sunlight). By early 1982, costs had dropped to between $9 and $12 per peak watt, depending on the volume of production. The Department of Energy (DOE) has set an ambitious goal: photovoltaic costs should be reduced so that solar electricity costs only 70 cents per peak watt by 1986, making it competitive with power from coal and nuclear plants. Most manufacturers contend that this price goal can't be reached by 1986, but all agree that the costs will continue to drop.

In 1980, the photovoltaic industry had $50 million in sales—mostly units for remote sites where solar power would cost less than extending the electrical grid. If the price reductions continue apace, photovoltaics could be a multi-billion-dollar industry by the late 1990s.

Willis, along with many other observers, believes that the industry will reach this potential only if it is competitive and if small businesses spur innovation. One line of reasoning is based on the generally accepted idea that small businesses are likely to be more innovative than big ones. For example, in an M.I.T. study sponsored by the U.S. Department of Commerce, David L. Birch concluded that businesses with fewer than 21 employees created 86 percent of all new private-sector jobs between 1969 and 1976.

There is also concern that domination by the oil companies represents a conflict of interest, and that they might suppress the development of solar energy. According to Alfred Dougherty, former director of the FTC's Bureau of Competition, "If oil companies control substantial amounts of alternative energy sources, and if they act in their natural self-interest, they may slow the pace of production in order to protect the value of their oil and gas reserves."

But DiZio, the American Petroleum Institute, and DOE are less concerned about concentration in the industry. They say that several semiconductor and electronics companies now pursuing photovoltaic research will soon enter the market, and this threat of future competition makes it unlikely that the oil companies will retard their own development efforts or inflate prices. Indeed, the Center for Renewable Resources—a nonprofit research group in Washington, D.C.—in a year-long study for the U.S. Small Business Administration, found no evidence that the oil companies have tried to bottle up the technology. However, says the study, they have discouraged competition and reduced the participation of small businesses through buy-outs.

But how likely are semiconductor and electronics firms to give oil companies a run for the photovoltaics money? Most already face stiff competition in their own fields, especially from abroad. For example, Japanese companies control 42 percent of the market for semiconductor chips, a fact that is forcing U.S. firms to specialize, not diversify. Given this situation, the major resources of the oil companies—who have every reason to de-

RICHARD MUNSON is executive director of Solar Lobby, a nonprofit organization in Washington, D.C. that promotes solar and conservation measures. BARRETT STAMBLER is a policy analyst at the Center for Renewable Resources. He is coauthor of *Competition in the Photovoltaic Industry: A Question of Balance* (Small Business Administration, 1982).

ILLUSTRATION: SUSAN FALLOWS

velop new markets as their primary resource increases in cost and decreases in supply—become another factor discouraging the participation of semiconductor and electronics firms.

Eye of the Beholder

In fact, oil companies seem to intimidate potential competitors. According to Robert Fellmeth, a University of San Diego law professor, "Much of the harm comes not from what oil firms do, but from what their competitors *perceive* they might do." If potential competitors become convinced that oil companies can and will cut prices to keep competition out of the market, their incentive is destroyed even if production and price levels would otherwise be attractive.

Indeed, 15 of the 16 independent photovoltaic companies interviewed by the Center for Renewable Resources felt that some oil companies have set "predatory prices" for photovoltaics—they have sold their product for less than the cost of producing it to gain a larger share of the market. This is illegal. Photovoltaic cells usually sell for $9 to $12 per peak watt. But some oil companies have sold cells for $7 to $8 per peak watt, a price most authorities believe cannot cover manufacturing costs. Arco Solar was accused most often, and the center obtained one invoice showing a bid of only $6.50 per peak watt. While Arco Solar and the other oil companies deny any wrongdoing, they do admit that they must market solar cells "aggressively" to compete with foreign firms.

And the foreign scene is bustling with activity. Japan and France spend more per capita on developing renewable energy than the United States, and investment there is increasing. According to a 1979 study by the Solar Energy Research Institute, the Japanese were at most a year behind the United States in research and development on photovoltaics—and by now that gap may have closed.

For example, Sanyo (a major Japanese electronics firm) recently predicted that solar equipment will account for $451 million of its annual sales by 1985. The firm is now constructing a $50 million plant to produce amorphous silicon cells in large volume. This is an important technological advance, since cells based on amorphous silicon will be considerably cheaper than conventional cells made from pure silicon crystals.

The solar-cell industry will boom only if it is competitive and if small companies spur innovation. But they face tough going against the oil giants that increasingly control the industry.

Unless their own prospects change and the spectre of predatory pricing and other unfair competitive practices fades, U.S. semiconductor and electronics firms won't soon enter the solar-cell industry. Yet if they wait, it may be too late. A few powerful firms controlled by oil companies may then dominate the industry, the costs of entry will be higher, and the returns for newcomers may not justify the risks. And if such problems pose serious obstacles to large electronics businesses, the challenges facing small firms are clearly even greater.

Wanted: a National Solar-Cell Program

The government still has the opportunity to prevent the centralization of power and to foster innovation and competition. (The growth of the semiconductor industry provides a precedent. The federal government did much to encourage the strong competition that has been a significant factor in the spectacular price reductions achieved since the 1950s.) What is needed is a national photovoltaic program that assures adequate capital for qualified small and medium-sized businesses.

In 1978, Congress approved $75 million in direct and guaranteed loans for small firms wishing to enter the solar market. Although the Reagan administration has sought to eliminate the program, Congress continues to appropriate funds. But these loans are not sufficient to meet the need. Government energy programs should allocate a larger percentage of their funds specifically for small businesses. Federal and state governments should provide additional capital by copying the model of California's Business and Industrial Development Corporation, which supplies revolving loans to small solar firms.

To monitor the photovoltaic industry thoroughly and systematically, the FTC and the Justice Department should survey the companies—both large and small—annually. On the basis of such data, federal financing, research, procurement, and regulatory procedures could be utilized to maximize competition. And to prevent predatory pricing, the FTC and the Justice Department should immediately investigate allegations of anticompetitive tactics. If illegal action is found, the guilty company should be prosecuted and prohibited from receiving government contracts.

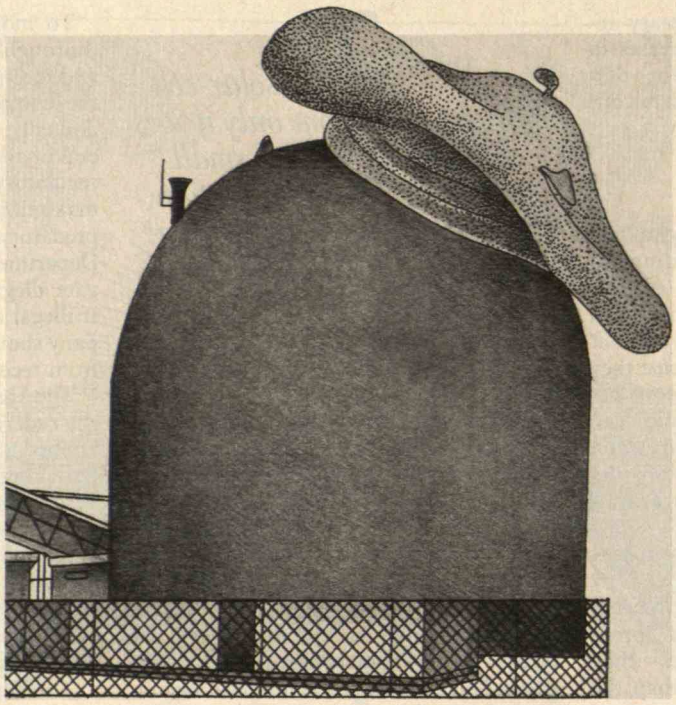
The Sherman Act, the Clayton Act, and the Federal Trade Commission Act can be applied to prevent oil companies from undertaking mergers, buy-outs, or other anticompetitive actions. Even without prosecution, which takes place only after an alleged infraction, the threat of action can make a company think twice. Unfortunately, the Reagan administration has been reluctant to challenge questionable business practices.

These goals will not be achieved easily, primarily because of the government's past actions regarding solar energy. The Carter administration, though it increased the budget for photovoltaic research and development, gave most of the money to affiliates of the large oil companies. For instance, in 1979, only 15 percent of DOE's solar funds went to small businesses. The Reagan administration has nearly abandoned the solar-cell program, cutting the 1982 budget by 66 percent (while increasing the nuclear-power program by 36 percent). And the 1983 budget request calls for another 50 percent reduction in funds for photovoltaics—to only $27 million. Demonstration and commercialization projects, which help small companies create markets for new energy devices, have largely been eliminated.

Still, a growing number of both Republicans and Democrats in Congress are becoming sympathetic to Robert Willis' concerns. They understand that without more assistance to small businesses and the increased innovation it will stimulate, there is risk that photovoltaic development may be retarded and that the related employment and economic benefits may go increasingly to foreign firms. Under this scenario, the United States could make the unfortunate energy transition from importing OPEC oil to importing Japanese solar cells. □

BY MICHAEL POLLAK

France: The Nuclear Dream Maintained



In Western Europe, the major expansion of nuclear power began in the early 1970s and increased sharply after the 1973 Middle East oil price increases. This generated a significant protest movement. Indeed, public opposition—combined with stagnant economic growth rates, increasing reactor construction costs, and considerable success in energy conservation—led many governments to modify their nuclear programs. The European Economic Community's original long-range plan projected that 172 plants would be generating a total of 160,000 megawatts of electricity by 1985. But by 1979, the EEC had lowered its nuclear forecasts to only about 70 plants generating 71,000 megawatts.

France was a notable exception. In the mid-1970s public protest was also widespread—but the ability of opposition groups to influence government policy rests only in part on their commitment. The conventional channels used in other countries to transfer nuclear protests to the level of national policymaking did not exist in France.

The courts consistently avoided extending their jurisdiction beyond procedural considerations, and despite a flood of legal actions they have remained peripheral to the nuclear debate. Regulatory procedures for licensing commercial nuclear power plants provided virtually no opportunity for public participation. And the centralized nature of the French government—combined with the state monopoly utility, Electricité de France (EDF), and the monopoly plant-construction firm, Framatome—allowed a technocratic elite to pursue its goals irrespective of outside pressures. (*See "The French Nuclear Harvest: Abundant Energy or Bitter Fruit?" November/December 1980, page 30.*)

MICHAEL POLLAK is a sociologist in the Program for Science, Technology, and Society of the National Center for Scientific Research in Paris. He is the coauthor with Dorothy Nelkin of *The Atom Besieged: Extra-Parliamentary Dissent in France and Germany* (M.I.T. Press, 1980).

Hopes that the government might curb its nuclear program were largely destroyed by the 1978 legislative elections. Both the Gaullists and the Giscardists, confirmed in power by these elections, strongly supported nuclear energy development. The Communist Party, although favoring nuclear energy, criticized the undemocratic nature of the decision-making process. The Socialist Party included factions holding differing ideas on nuclear power, with a minority wing advocating a nuclear-energy freeze.

Then came a political upheaval: in the spring of 1981 François Mitterrand, leader of the Socialist Party, was elected president. Antinuclear activists saw the door opened at least slightly, and the protest movement was revitalized locally and nationally.

Goodwill Gestures

During the presidential campaign, neither Mitterrand nor incumbent Valéry Giscard d'Estaing made nuclear energy a major theme. Giscard d'Estaing presented himself generally as the candidate who would guarantee continued economic prosperity. Mitterrand remained ambiguous about the nation's nuclear program—mindful of his party's various factions—but he did promise an open approach to decision making, including a governmental debate on energy policy.

After taking office, Mitterrand called for new legislative elections. Socialist candidates, confronted in many localities with significant public opposition to planned nuclear-power plants, promised to stop construction. This was true even at La Hague, where ecologists and union activists had long fought the proposed expansion of a spent-fuel reprocessing plant, already the largest in the West and viewed by many as a symbol of France's commitment to nuclear energy.

The Socialist Party won a majority. As one of its first measures, the Socialist-Communist coalition government voted on July 30 to freeze planning and construction at five sites. Also, no new licenses would be granted and construction was prohibited where a license was already granted but construction not yet underway. A proposed plant in Plogoff on the Brittany coast, where local opposition had been the most radical, was permanently abandoned. Also as promised, the government scheduled a parliamentary debate before it would decide on long-range plans for nuclear energy. At last, the government seemed willing to seriously consider antinuclear criticisms.

A parliamentary commission was appointed to prepare for the energy debate, which was scheduled for early November. Paul Quiles, the Socialist energy-policy spokesman known for his ecologist sympathies, was named chairman. The commission presented a plea for a "rational" energy policy, and cited the need to separate national economic growth from increasing energy consumption. Its report endorsed the development of alternative energy sources and government incentives for energy conservation. It underlined technical uncertainties in nuclear plant operation, fuel reprocessing, and radioactive-waste disposal. And the large-scale development of fast-breeder reactor technology, a key policy goal of previous governments, was criticized on technical, safety, and economic grounds.

ILLUSTRATION: IRENA ROMAN

More fundamentally, the report scored the undemocratic nature of the government's decision-making process, arguing in favor of open hearings prior to power-plant licensing. And it stressed that the parliamentary energy debate should be only the first step toward a national public debate. Critical of past policies but leaving open several options for the future, the report satisfied most people, including the ecologists. Indeed, the media presented it as a symbol of the open and democratic political style of the new government.

A Change of Heart

As the debate drew closer, however, it became clear that the government did not really look on the event with much favor. Several factors were involved. Such debates in other European countries had served to reinforce antinuclear sentiments and stir up political whirlwinds. In Sweden, for example, public opposition to nuclear policy contributed importantly to the 1976 defeat of the Social Democratic government after 44 years in power.

The government also seemed convinced that its new policy of sweeping structural changes in the economy—including the nationalization of banks and high-technology industries—could succeed only in a stable environment. The pro-Communist Confédération Générale du Travail (CGT) union had mobilized against a nuclear freeze, fearing that the already-high unemployment in the construction industry would increase. And the traditional French desire for independence—in energy as in other matters—was at work as well. It no longer seemed politically feasible to abandon or greatly reduce the nuclear program.

The parliamentary debate was held as scheduled. Moving swiftly to avoid lingering controversy, the government soon announced its final nuclear energy program. Construction was to continue on three of the five sites "frozen" a few months earlier—Cattenom, Chooz, and Golfech—and three new plants were scheduled to be built in 1983. This represents a 30 percent reduction in the construction volume originally proposed for 1982 and 1983, but it is not a significant change in the overall nuclear program. At most, the majority of the plants originally proposed will be producing power after only a few years delay. This means that nuclear power, with 30 reactors currently supplying roughly 35 percent of the nation's electricity, will supply about 75 percent by 1990. The government also decided to continue to expand the La Hague fuel-reprocessing facility, and to finish construction of the fast-breeder reactor at Creys-Malville.

The only significant change was that the "new" policy established a procedure by which municipalities can vote on a proposed power plant. If they refuse construction the matter goes to a regional council. A negative decision there sends the issue to the national parliament for the final say. At most, this relatively timid opening of the decision-making process can delay a decision for a few months. Even then, the national utility monopoly, EDF, can offer compensation to municipalities before they vote on a project in an effort to avoid even short delays.

An Ambiguous Victory

The government's decisions provoked massive demonstrations in many municipalities. But as the government hoped, public interest quickly turned to other, more immediate preoccupations, including inflation and rising unemployment. The divisive question of nuclear energy was effectively removed from the policy agenda—but this may prove illusory over the longer run.

Public-opinion polls suggest that while roughly 60 percent of the French population now supports nuclear energy, opposition is strong among younger people. And young people contributed greatly to Mitterrand's and the Socialist victories in 1981. Their disappointment with the government's return to "business as usual" in nuclear energy might lead to a disillusionment not only with party policies of the Left but with politics in general.

The result could well be increased social protest. In other European countries, recent protest movements have focused on concerns about the link between civilian and military use of nuclear power. Specifically, young protestors might become the catalysts for widespread public outcry about French plans for fast-breeder reactors, which produce plutonium that can be used to manufacture nuclear weapons. After the fast-breeder reactor at Creys-Malville is completed, the nation will face the choice of building more such reactors, which could take France the final step into the plutonium age. □

How Exxon the mysteries

Scientists like John Sinfelt, Terry Baker and Dan Dwyer may one day enable us to design catalysts to order.

Catalysis has been a critical factor in the evolution of the petroleum industry. Catalytic conversion has made possible the majority of today's petroleum refining and synthetic fuels processes, as well as a large number of petrochemical processes. Our present understanding of the fundamental pathways of catalysis, however, is still extremely limited, largely due to past limitations in our analytical capability.

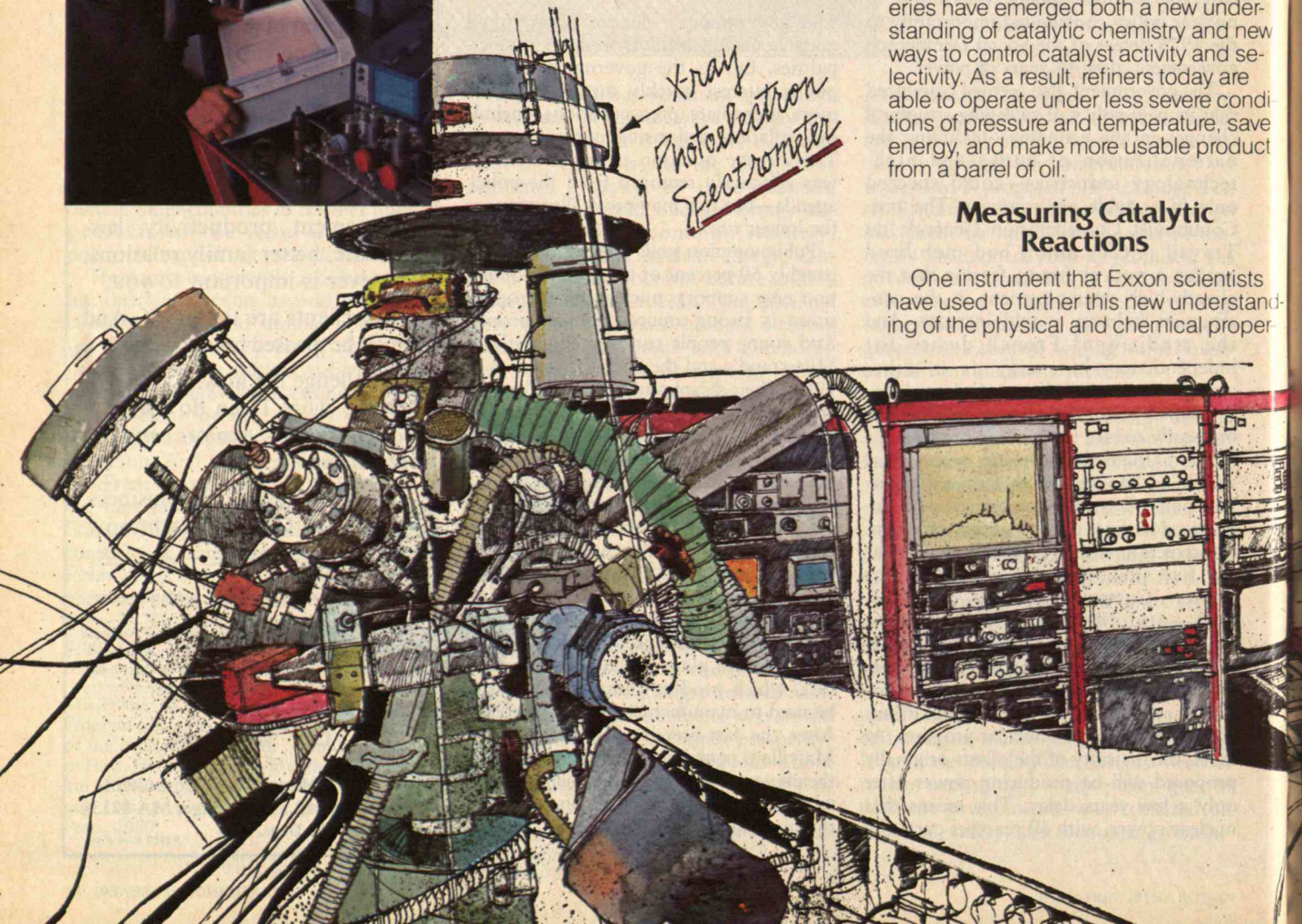
Traditionally, scientists evaluated a catalytic material simply by placing it in a reactor, admitting feed under suitable conditions of temperature and pressure, and examining the resultant products. This "black box" approach rendered it virtually impossible to link catalyst structure with reactivity. Hence, in years past the finding of a new catalyst owed more to art than to science. But today, scientists at Exxon are using advanced instrumentation with extraordinary capabilities to examine catalysts at work at the atomic level.

Fundamental Discoveries

In the mid-1960s, scientists at Exxon Research and Engineering Company (ER&E) made the fundamental discovery that supported bimetallic catalysts were vastly superior to supported single metallic catalysts. These catalysts, for example, have made it possible to produce high-octane gasoline without tetraethyl lead. Further research by ER&E led to the realization that all catalyst support materials modify to some extent the structure, electronic properties and chemical behavior of catalysts. From these discoveries have emerged both a new understanding of catalytic chemistry and new ways to control catalyst activity and selectivity. As a result, refiners today are able to operate under less severe conditions of pressure and temperature, save energy, and make more usable product from a barrel of oil.

Measuring Catalytic Reactions

One instrument that Exxon scientists have used to further this new understanding of the physical and chemical proper-



is solving of catalysis.

ties of catalysis is an x-ray photoelectron spectrometer coupled to a high-pressure catalytic reactor. Operating either under ultrahigh vacuum or pressure conditions, this novel device–one of only a handful in the world–not only measures the presence and strength of a metal support interaction, but also tests catalytic activity. Using a dedicated computer to analyze the tremendous amount of information generated in these reaction studies, researchers are unraveling the structure and reactivity of the catalytically active site.

Watching Catalysts at Work

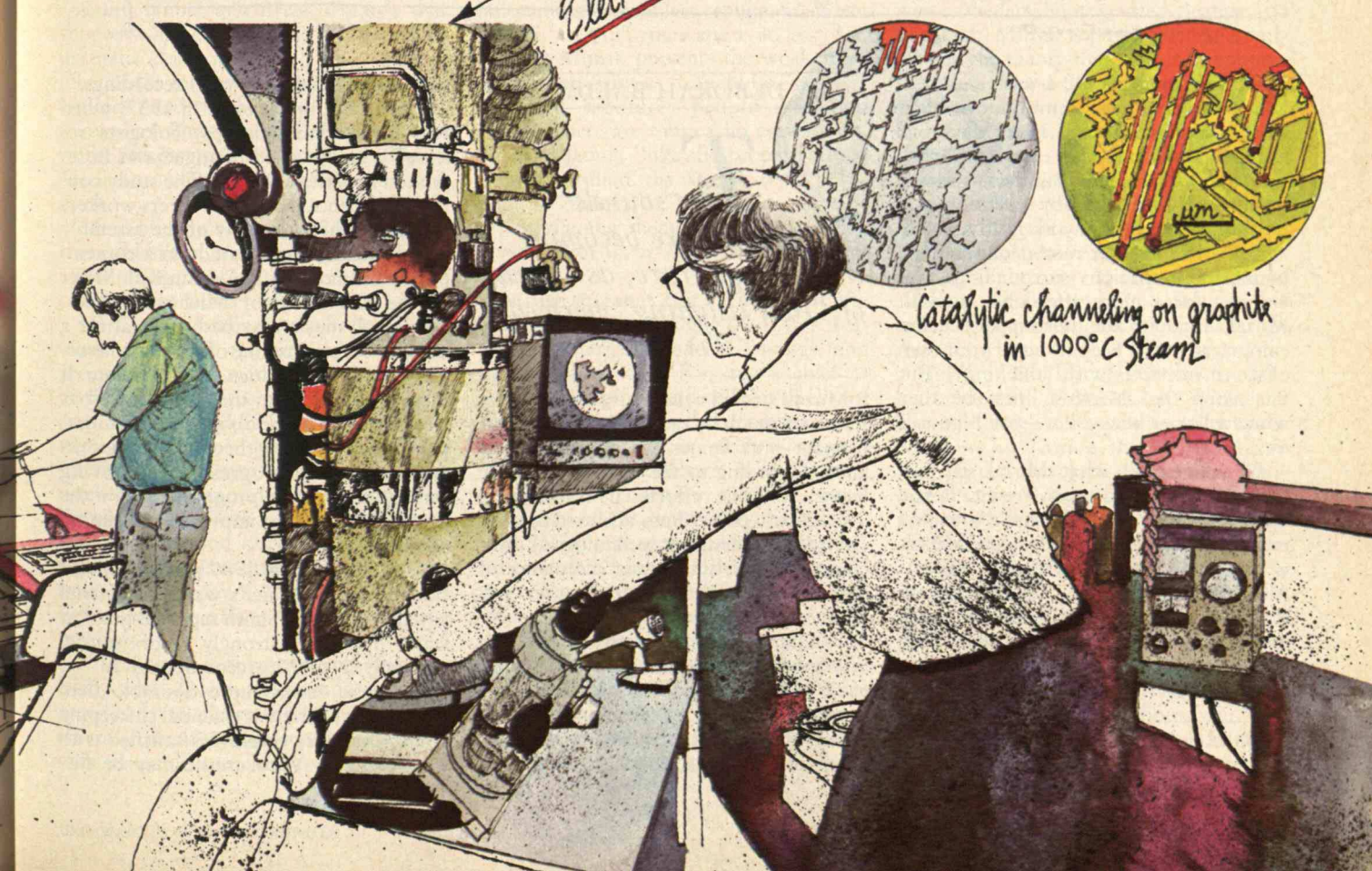
As a second approach to the study of catalysis, scientists at ER&E are using advanced surface analysis techniques to observe a catalyst at work. A specially equipped Controlled Atmosphere Electron Microscope is enabling researchers to examine, at the atomic level, the relationship between the structures of catalytic surfaces and the chemistries that occur there. This instrument, too, is one of only a few in the world, and the only one being used in private research. It has proved vital to our understanding of the kinetics and mechanisms of coal gasification.

Recognizing the importance of such *in situ* characterization, Exxon is further developing analytical instrumentation to probe both the catalyst and the reacting molecules while the catalytic reaction is in process. Using infrared, visible, ultraviolet and x-ray radiation, this sophisticated equipment could dramatically widen the horizons of catalysis, and one day enable us to design catalysts to order.

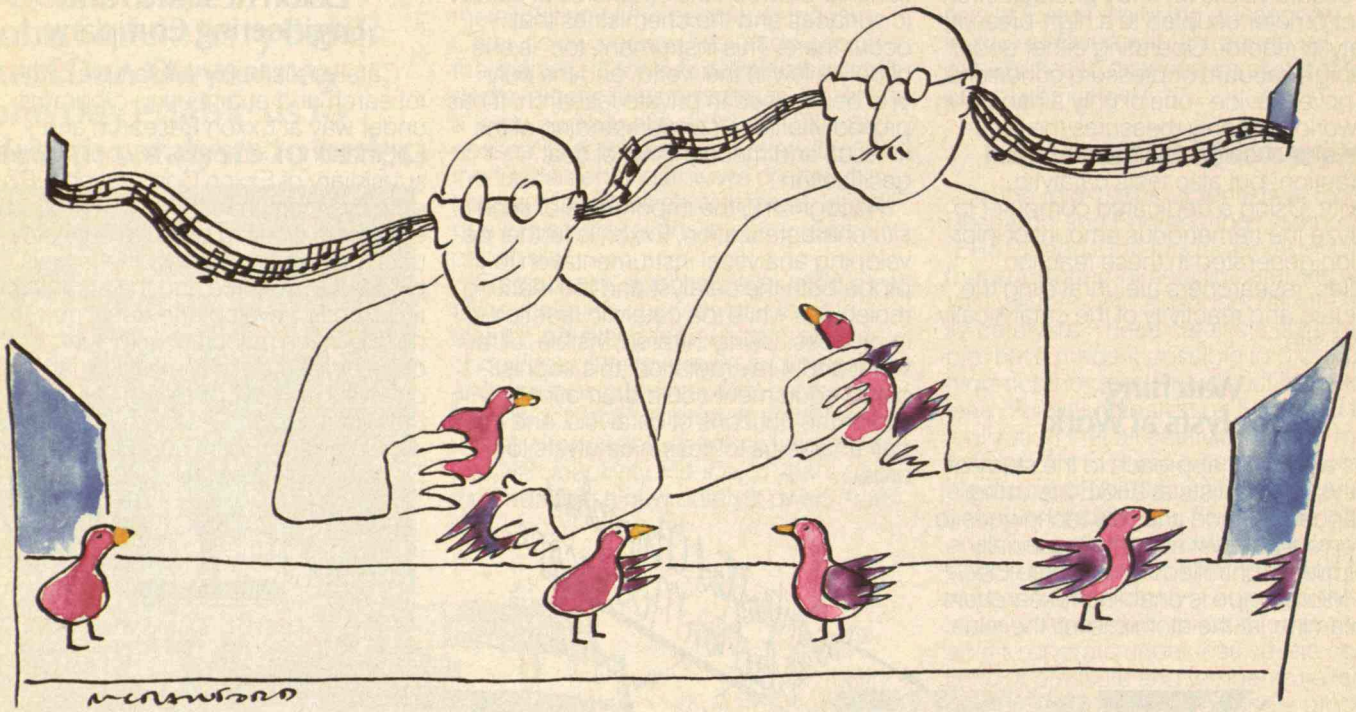
Exxon Research and Engineering Company

Catalysis is but one example of the research and engineering programs under way at Exxon Research and Engineering Company. A wholly owned subsidiary of Exxon Corporation, ER&E employs more than 2,000 scientists and engineers working on petroleum products and processing, synthetic fuels, pioneering science and the engineering required to develop and apply new technology in the manufacture of fuels and other products. For more information on catalysis or ER&E, write Ed David, President, Exxon Research & Engineering Company, Room 607, PO Box 101, Florham Park, New Jersey 07932.

EXXON



Muzak to My Ears



BY DEBORAH BALDWIN

The sounds of silence are becoming increasingly rare, as strains of "easy listening" permeate the air.

YOU'RE manager of a vast and restless workforce. Turnover is high, worker satisfaction low. Every day your minions pile into the contemporary equivalent of a beehive. But the drones are rebelling. They're bored by repetition, and repetition is what the work is all about.

You'd like to offer raises, longer lunch hours, more spacious surroundings, but you opt for a more affordable cure-all: Muzak. If you're like most upper-echelon employers, you'll keep it out of your own office (it interferes with "thinking"). But out along the assembly lines—be they white collar or blue collar—you'll pour it on.

To understand what Muzak is, you have to understand what it isn't. If you think it's posing as music, that's your first mistake. Music is entertainment; Muzak is not. "It's a business tool," explains Allen Smith, president of the Muzak franchise in Washington, D.C. He points to a number of studies done in the 1930s that link Muzak to increases in worker productivity.

DEBORAH BALDWIN is a Washington, D.C.-based writer.

Muzak's role in the workplace saved it from sure death by radio. Muzak was first brought into homes via electric power lines. According to the official corporate history, "While efforts at transmitting over electric power lines achieved impressive results, persistent technological difficulties and the burgeoning acceptance of commercial radio made further experimentation impractical."

Undaunted, the company moved into new spheres. Abandoning the home audience, the Muzak Corp. marketed its services—this time via telephone lines—to hotels and restaurants. During the Depression Muzak also made the fortuitous switch from shellac to vinyl recordings.

But the big break came in 1937, when two British industrial psychologists released a study called "Fatigue and Boredom in Repetitive Work." The study contained evidence that music cheers workers sapped by the monotony of the assembly line. Summarizing the study in a contemporary business text, Norman R.F. Maier of the University of Michigan writes, "Although music may be beneficial for a number of reasons, one of the most favorable effects is its influence on boredom. It takes the mind from the work as well as frees the brain of the obligations of initiating the activity." He theorized that workers experience progress by "moving through the musical programs, even if the job tends to give the impression of getting nowhere."

A second study in 1947 reached similar conclusions. In Maier's words, industrial psychologist H.C. Smith reported that "at least 75 percent strongly favor (music) and only 1 to 2 percent oppose it. . . . Slow music seems more desirable than lively music; variety is essential to keeping young and older employees satisfied with the programs. Vocal music may be dis-

ILLUSTRATION: MICHAEL CRAWFORD

More than just music, Muzak is a business tool. And supporters say the benefits for workers outweigh the grumbles of a few "eggheads."

tracting for some employees, and music with strong beats may disturb or aid depending on how it fits into the rhythms of the job."

The timing of the initial study couldn't have been better. Its promoters claimed Muzak helped spur defense workers on to new heights of wartime productivity. And as industry boomed during the postwar era, so did Muzak. The company rapidly made the transition to selling its product for use in white-collar environments such as banks and insurance companies, and has been growing ever since.

Muzak enthusiasts such as Allen Smith pooh-pooh the charge that an anguished minority hates the stuff. The benefits for the majority of the workforce, he points out, more than compensate for the grumbles of a few irrational "eggheads." He estimates that the cost of soothing employees in the average insurance firm is a mere .08 cents per worker per month. "The morale factor alone—not to mention ambiance—is intangible. The employees favor it. They know management is trying to create a warm, friendly environment."

Smith points to current research that supports his claims. One of the more dramatic cases involves a 1972 experiment at the midtown Manhattan office of United Medical Service, Inc. (better known as Blue Shield), where workers were processing an average of 87,578 Medicare claims via computers each week.

Mind-blitzing work, you say? Nothing that couldn't be improved by the sound of 1,001 strings. Muzak claimed an 11 percent jump in worker productivity.

Here, as in other workplaces, Muzak Corp. marketed its popular "stimulus progression" to raise the spirits of a dispirited workforce. Stimulus progression, introduced in 1948, entails alternating 15 minutes of functional music with 15 minutes of silence "to offset fatigue in listeners as it varies during the course of the office day. With its varying rhythm, tonality, and total impact, Muzak is designed to stimulate differently at different times of the day." Muzak offers two types—one for offices and the other for factories.

Muzak is the only company that records and distributes sounds designed specifically to please the majority of listeners. Muzak's orchestrators arrange a wide range of musical hits from classical to country and record them in various studios around the world, avoiding the use of blaring trumpets, high-pitched strings, and other annoyances. As Rod Baum, Muzak's vice-president for programming, explains: "We don't want to astound or horrify people." The segments are then rated from one to seven based on "tempo, texture, and intensity."

Baum keeps track of them in a computerized bank that contains about 35,000 tunes. When the time comes to put together a day's program, he schedules the more stimulating segments for times when workers need a lift: midway between breakfast and lunch and again in mid-afternoon. He transmits his products to a New Jersey ground station, where they are beamed to satellites and then back to receptor stations. From there Muzak is distributed via radio and microwaves.

Screening Spy Talk and Cursing

Why does it work at all? In the words of James Mosell, professor of industrial and organizational psychology at George Washington University, "External stimulation makes a task less repugnant. When work is stressful, you want to do less of it. Perhaps Muzak prevents the work from being as stressful as it might be."

Mosell separates people into two camps. There are those who crave external stimulation, "like the people you see running around the streets with headphones." Others, he believes, are capable of entertaining themselves with "private reverie." For them, Muzak can be an annoyance.

A case in point can be found at the headquarters of Washington D.C.'s Perpetual American Federal Savings and Loan. Jeffrey Frey, Perpetual's chief of new construction, ordered hundreds of Muzak speakers for the company's immense futuristic offices, where 90 percent of the workforce labors in those now near-universal open-air modular units. All's quiet on the supervisory front, however. "Most managers don't like Muzak," he concedes. Nor, studies conclude, do most people with relatively interesting jobs.

But as Muzak's Smith points out, background sounds are favored in any workplace lacking floor-to-ceiling walls. Without Muzak, workers are easily distracted by the more interesting sounds of coworkers making personal phone calls. Some designers of contemporary workplaces write Muzak right into their blueprints. Obviously, Jeffrey Frey is a believer—he feels that Perpetual's $362 monthly fee is well worth the investment.

Muzak has many other fans. AT&T, IBM, and Xerox use it in their paper-processing divisions. And it's big in the federal bureaucracy, where it not only soothes stressed file clerks but drowns out spy talk at the CIA. (The White House, which boasted Muzak service during the Eisenhower and Johnson administrations, claims to carry out its mission in silence these days.)

Muzak is not strictly a workplace phenomenon. Restaurants use it to drown out the noise of competing dinner conversations. And "telephone capability," as it is known among insiders, allows salespeople to put customers on "hold" without abandoning them to the sounds of their own cursing.

Remarkably enough, Dr. Frank B. Flood, chief of cardiology at St. Joseph's Hospital in Yonkers, N.Y., reported that recovery rates among coronary patients improved when the intensive-care unit was bathed in homogenized Beatles and Bachrach. Muzak is piped into supermarkets on the theory that it invites shoppers to linger around the impulse items. And where would the airlines be if passengers had to fly in anxiety-ridden silence?

But musicians say that Muzak, in attempting to be all things to all listeners, turns creative compositions into mush. Hugh Wolff, associate conductor of the National Symphony Orchestra in Washington, D.C., says Muzak threatens to "debase the currency," rendering all music less meaningful to the average American.

However, Wolff's admonitions are falling on already deafened ears. With each leap in Muzak's use has come new ways to distribute it. During the 1950s Muzak spearheaded development of the automated tape-playing studio, which hardly needed a human being to move its music out by way of FM radio substations.

While doggedly keeping pace with a changing world, Muzak Corp. has enlarged its visions. No longer promoting its product as merely a "business tool," the company now claims to create a better environment. Whether Muzak can really do that depends on whom you ask. Beauty, when it comes to music, is in the ear of the listener. □

KEY THINGS TO REMEMBER IF YOU'RE TRYING TO SELL THE JAPANESE.

One of the most difficult challenges facing American business has been to find a way to sell to the Japanese. We think we have a solution.

It's a simple strategy and involves only a few basic steps. But it has worked for us.

Instead of just talking about building quality products, years ago we committed our entire company to doing it. And in living up to that commitment we've proven that with the right approach American manufacturers can meet the Japanese on their own home grounds.

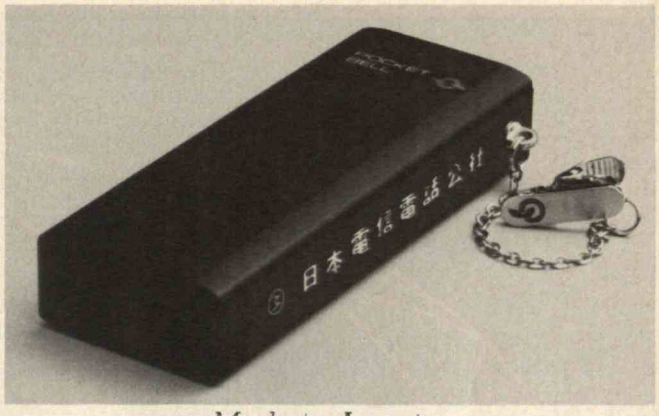
A big key to success is having a strong enough commitment to get through the tough initial stages. We learned this in 1978 when, with the encouragement of the U.S. government, Motorola decided to compete for some of the electronics business traditionally awarded only to Japanese companies by Japan's giant Nippon Telegraph and Telephone Public Corporation.

It was a bold undertaking that required substantial investments of time and money. In fact, just to enter the competition it was necessary to complete an exhaustive survey of competitive products and to translate and study all the pertinent Japanese specifications.

But if you want to sell to the Japanese you have to make the effort. So we did it.

Then we did something even tougher. We committed ourselves to exceeding the quality standards they set for us.

And succeeded. In early 1982, after competing with a number of Japanese electronics manufacturers, Motorola demonstrated in rigorous testing that our pagers exceeded NTT's reliability standards, while complying with their strictest price and delivery requirements.



Made in America.

As a result, Motorola was officially qualified by NTT as a supplier of pocket pagers. The first and only non-Japanese firm ever admitted to this heretofore closed group.

Orders for over 50,000 Motorola pocket pagers are expected this year alone.

In striving to exceed quality and reliability standards, though, it is equally important to maintain high standards of customer service.

We are convinced that this success in the Japanese market is due largely to the way we approach every one we serve.

It's a simple common sense way of doing business that says we pay as much attention to the wants and needs of our customers as we do to the quality of the products we make for them.

We think there's one other basic factor that's also responsible for Motorola's success in selling to the Japanese. Our participative management attitude.

One of our goals is to make every Motorola employee in every Motorola plant an effective part of the management team of our company. And because employees are motivated by this chance to participate and are rewarded for their efforts, we've found we're able to bring to bear on every product we make the enthusiasm, the dedication, and the attention to detail that result in the highest kind of quality.

The kind of quality that has allowed an electronics company like Motorola to sell in a country where they make some fine electronics themselves.

MOTOROLA A World Leader in Electronics

Quality and productivity through employee participation in management.

Continued from page 5

cent, while defense R&D will enjoy an 11 percent increase. As a percent of the gross national product, total federal outlays for R&D will decrease by 3.2 percent.

Basic research has fared no better. Federal expenditures for basic research will increase by 2.7 percent in constant dollars. Defense-related basic research will rise by 13.8 percent, while nondefense expenditures will rise by only 1 percent. As a percent of the gross national product, federal outlays for basic research will *decrease* by 6.4 percent.

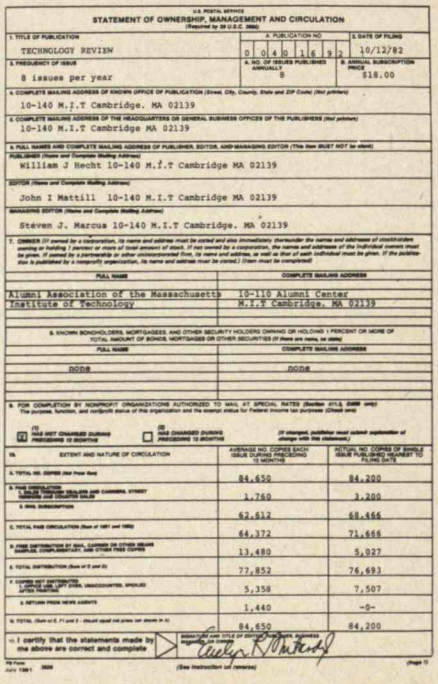
Rashid A. Shaikh
Boston, Mass.

Upcoming in our January issue

Electricity from the Wind
It is no panacea, and commercialization is proceeding slowly. But wind power could become an important industry in the 1990s.

Technical Fixes at the White House
A presidential parable; or, what every executive — from low-level to chief — should know about management systems.

How Goes the Wired Nation?
Cable TV: Its basics and its political, social, and economic implications.



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Memoirs of a Bubble Blower

BY BERNARD ZUBROWSKI

Shimmering and intricate as they grow and change, soap bubbles fascinate nearly everyone. And blowing bubbles is a rich but overlooked approach to learning, providing insights in areas from the perceptual to the philosophical.

In teaching science to children, I have found that the best topics are those that are equally fascinating to children and adults alike. And learning is most enjoyable when teacher and students are exploring together. Blowing bubbles provides just such qualities.

Bubble blowing is an exciting and fruitful way for children to develop basic intuition in science and mathematics. And working with bubbles has prompted me to wander into various scientific realms such as surface physics, cellular biology, topology, and architecture. Bubbles and soap films are also aesthetically appealing, and the children and I have discovered bubbles to be ideal for making sculptures. In fact, looking over the past ten years I can see a certain philosophy emerging—a sort of Zen and the art of bubble blowing.

Patterns in Bubbles

Adults tend to think of bubbles as a visual phenomenon, but I suspect children are initially more intrigued by their kinetic qualities. Soap film is very sensual as it expands, moving like Jello, sometimes with the entire bubble swaying from side to side. In the film itself, amoebalike spots swim through stratified layers of brilliant color. And there is a special quality—artistic? scientific?—in the way bubbles clump together. Though they seem to have an intricate complexity, the bubbles in a cluster actually take only two basic geometric configurations.

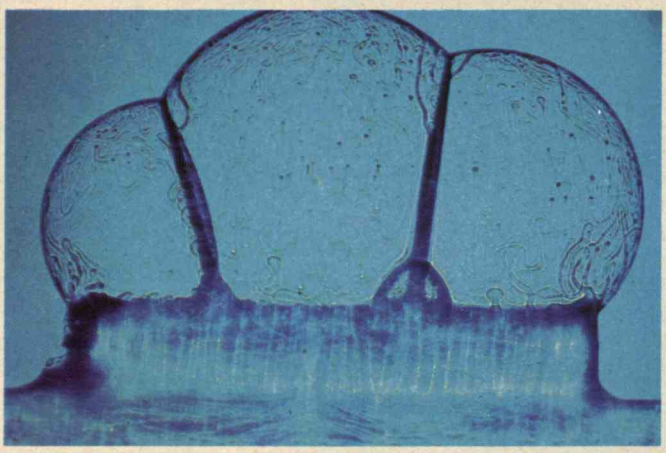
Such bubble behavior is featured in exhibits I've developed at the Children's Museum in Boston. In one exhibit, children generate a froth of bubbles between two plexiglass sheets spaced half an inch apart. The bubbles form a two-dimensional hexagonal array similar to a honeycomb, with three bubble surfaces always meeting along a line at angles of 120 degrees. In another exhibit, the children go a step further by creating three-dimensional clusters of bubbles that rise up a plexiglass tube. These bubbles are not as regular as those in the honeycomb formation, but closer observation reveals that they have a definite pattern: four bubbles (and never more than four) are usually in direct contact with one another, with their surfaces meeting at a vertex at angles of about 109 degrees. And each bubble in the cluster will have roughly the same number of sides, a fact that turns out to be scientifically significant.

In the 1940s, E.B. Matzke, a well-known botanist who experimented with bubbles, discovered that bubbles in an array have an average of 14 sides. That is, the "average" bubble has the shape of a 14-sided polyhedron. And that's important because 14 is the number of faces of the so-called "Kelvin cell." Proposed by Lord Kelvin in the late 1880s, this is the ideal geometric shape for enclosing space, requiring the minimum surface area and tension to enclose a given volume.

This may seem to be another of those esoteric facts scientists bandy about, yet it bears on a wide range of structures. For example, scientists have noted a consistent similarity between soap-bubble arrays and such diverse things as human fat cells, plant cells, cells of dragonfly wings, spots on a giraffe, cracks in dried mud, the way lead shot compacts, and the granular structure of metals. Peter Pearce, in *Structure in Nature Is a Strategy for Design,* says that soap-bubble arrays "can be taken as the model or type of all systems—biological, physical, chemical—in which there is an economical association of cellular modules." What I hope children will gain from playing with bubbles is the realization that there are many patterns in both natural and human-made phenomena, and that discovering and explaining such patterns is a vital part of science.

BERNARD ZUBROWSKI is on the staff of the Children's Museum in Boston. He holds an M.S.T. in chemistry and education from Boston College and is the author of numerous books that describe science experiments using household materials. *Water Pumps and Syphons* (Little, Brown, 1981) won the New York Academy of Sciences' 1982 award as the best science book for young children.

PHOTOGRAPHS: WALTER BIBIKOW



Children "at work" at the Children's Museum in Boston. Soap bubbles provide vivid examples of many geometric shapes and spark discussions of mathematical concepts. Architects also use bubble arrays, such as the simple cluster above, as structural models. The Pneu Dome (left) is an early product of Crysalis Corp., designed for those who want a bubble in their backyard.

PHOTOGRAPHS: WALTER BIBIKOW, CHRYSALIS CORP., AND FUTURE TENTS

Architects have also capitalized on bubbles as what Pearce calls "an elegant demonstration of minimal principles." (Bees, nature's superb architects, demonstrate minimal principles at work: the configuration of a honeycomb contains the greatest amount of honey with the least amount of beeswax and requires the least energy to construct.) Frei Otto of Germany is a pioneer in this field, with numerous bubble-inspired structures to his credit: large balloonlike buildings and huge tents with sweeping lines. Although Otto doesn't simply build a scaled-up version of a small bubble array, he finds soap-film models useful in determining such things as the minimal surface area and the stresses that will occur in his structures. Indeed, "bubbles" are becoming an increasingly familiar sight in many cities, with tennis courts and other athletic facilities sporting air-supported domes based on the structure of bubble arrays. So soap bubbles are useful in understanding structural arrangements from the micro to the macro.

Lessons to See and Feel

Having played with bubbles for so long with children, I am convinced that educators are overlooking a rich opportunity. Manipulating soap films involves both the visual and the haptic senses; that is, what we see and how our bodies sense movement. The shapes that bubbles take are similar enough to encourage the search for patterns, yet they are always different enough to arouse anticipation. These properties prove to be irresistable to almost everyone, from children in African villages to those in suburban Boston. The educational value is that the material, not the teacher, is the motivator. This doesn't negate the teacher's role, but suggests that here is something worth exploring for its own sake.

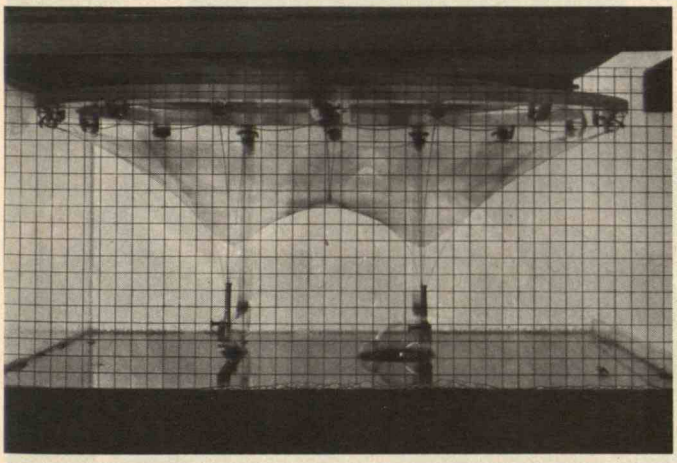
These qualities were dramatized for me as I blew bubbles with a blind child. He would wet one hand with soapy film and then, by blowing through a straw, would form a bubble on his hand. He could sense when the bubble began forming and how big it grew. And when it broke, the warm air in the bubble would disperse—a clear indication that it was gone. The boy grew excited each time a bubble expanded to cover his hand, and afterward he exclaimed that he had never experienced bubbles so large.

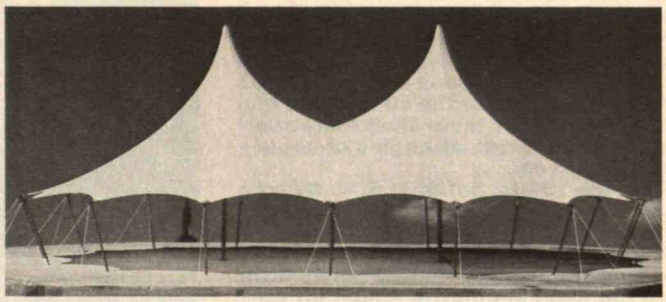
In another instance, I videotaped children playing with the exhibits in the Children's Museum and observed a girl who spent 45 minutes with the same contraption. It was simply some sticks and string that, when pulled out of the soapy water, made a two-by-three-foot film. I discovered that the girl developed a repertoire of manipulations that produced a variety of curved surfaces and geometric shapes. Though I am sure she could not have explained exactly what she had generated, her face and gestures indicated deep concentration and satisfaction.

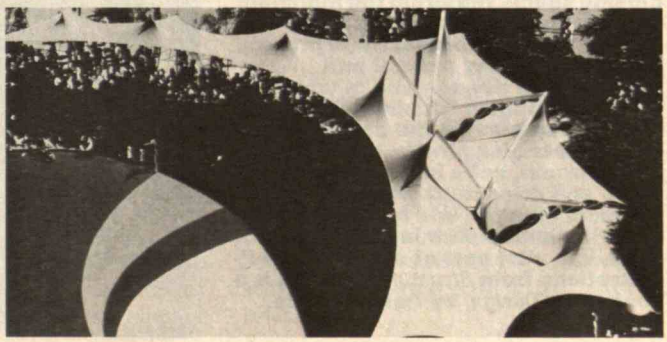
Geometry in Action

On a conceptual level, bubbles can help illustrate a variety of mathematical relationships. In fact, mathematicians have studied the principles governing the geometry of soap films for at least two centuries. For younger children, bubbles and their arrays serve as vivid examples of many geometric shapes, such as the sphere, hemisphere, pentagon, and hexagon. Creating and feeling these shapes is much more dramatic than simply seeing them portrayed two-dimensionally in a drawing. With older children, bubbles will spark discussions of concepts such as angles, surface areas, perimeters, and volumes of various geometric shapes. For example, by making a bubble grow larger they can begin to see the relationship between volume and diameter—often a difficult concept to convey—and they can make direct measurements to confirm their observations.

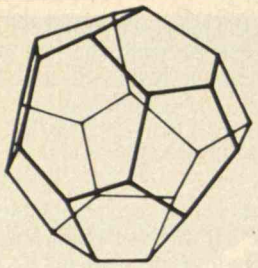
Indeed, I feel a bubbles "curriculum" could be developed that would span the educational time line from preschool to postgraduate. Students can return to bubbles time and again and delve more deeply into their geometry. This approach

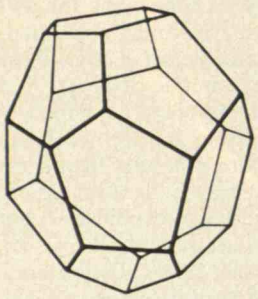


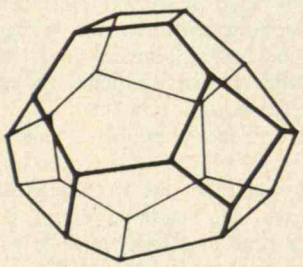


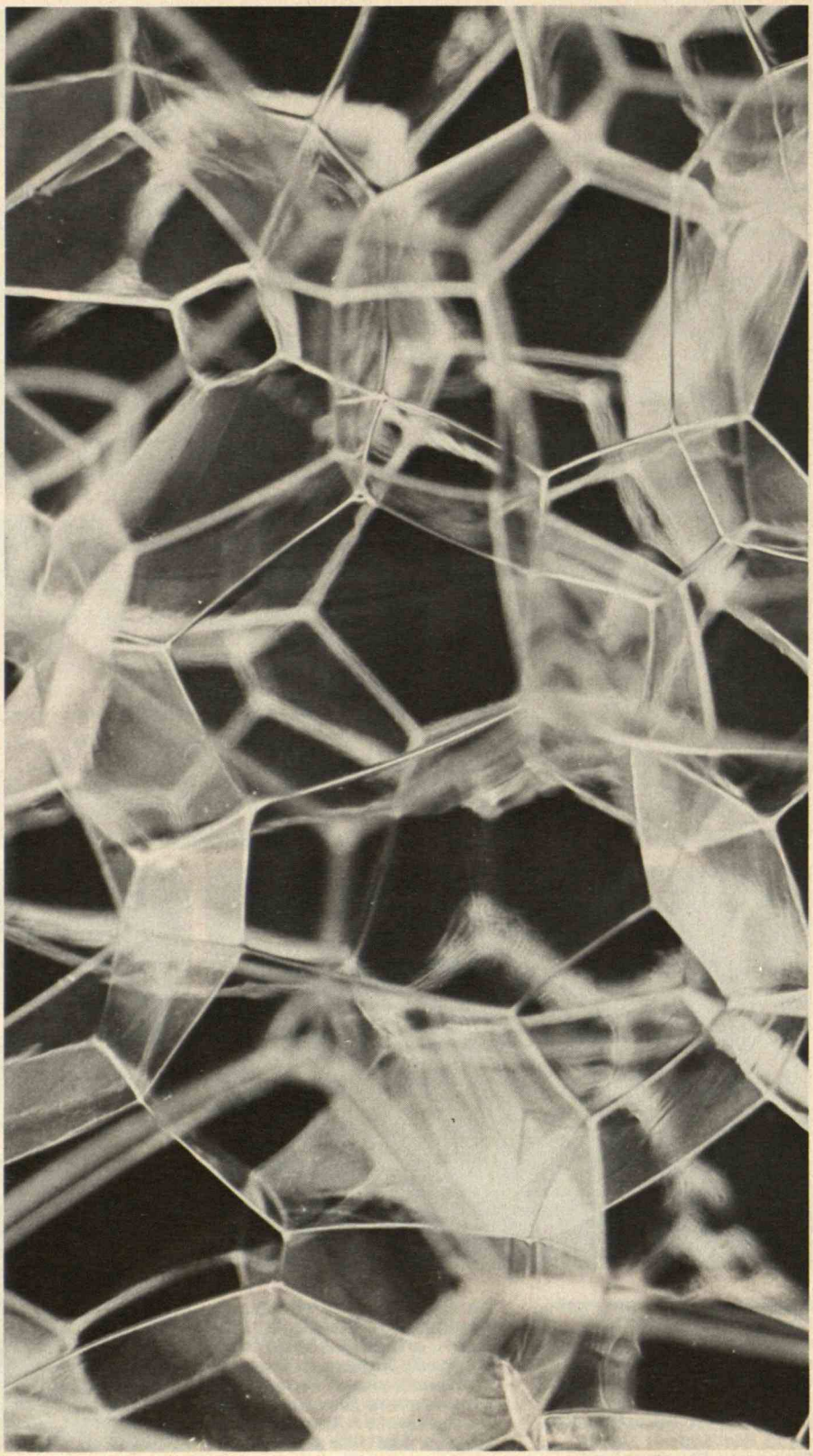


Soap films illustrate "minimal principles." The machine above enables designers to determine the surface area and stresses in the structure produced by inverting the soap film (upper right). The soap-film-inspired pavilion at lower right, designed by Chrysalis Corp., provides shade for Kennedy Square in Detroit. Any shape that bubbles or soap film take can be duplicated in an air-filled or tentlike structure.



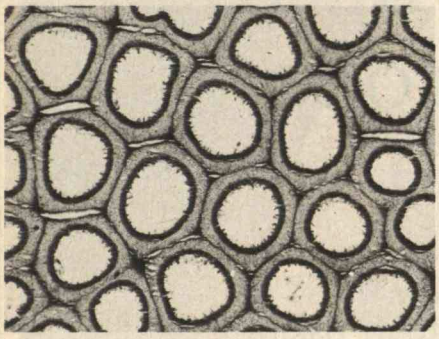


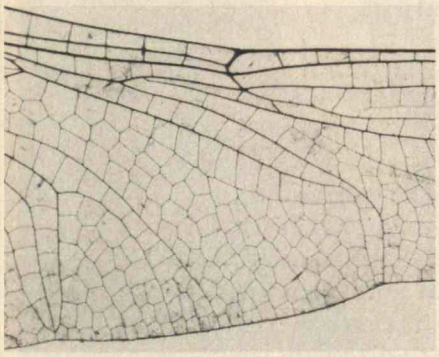


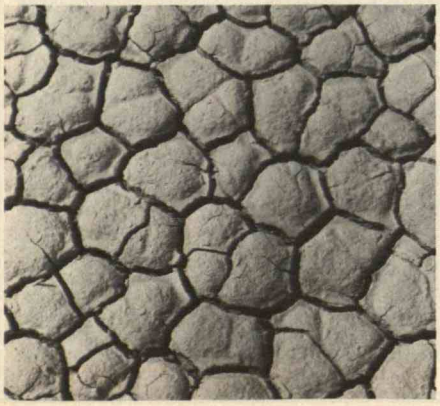


Bubbles in a cluster follow mathematical laws and take only two basic geometric configurations. Three surfaces can meet along a line at angles of 120 degrees, or the surfaces of four bubbles (never more than four) can meet at a vertex at angles of about 109 degrees.

In the 1940s, botanist E. B. Matzke discovered that bubbles in such an array have an average of 14 sides. Examples of the shapes he noted are shown above. A 14-sided polyhedron is the ideal geometric shape for enclosing space, requiring the minimum surface area and tension to enclose a given volume. Bubbles, then, provide a model for many natural and human-made phenomena in which structure follows "minimal principles." Examples on the opposite page: spots on a giraffe, underside of a mushroom, cells in a dragonfly's wing, and dried mud. By playing with bubbles, children will learn that discovering and explaining these patterns is a vital part of science. (All illustrations from *Structure in Nature Is a Strategy for Design*, by Peter Pearce, M.I.T. Press)







to learning may be quite different from conventional methods but is just as valid. Teachers usually explain concepts and then try to illustrate them through demonstrations or experiments. But with bubble blowing, the concepts arise out of the materials—much closer to the way we learn in everyday life. And all the while students are working with a beautiful and intrinsically interesting phenomenon.

I have yet to mention all the possibilities that stem from a soap film's interaction with light. Only by practice does a child develop the perceptual skills important in cognitive growth. Playing around with soap film—watching how the patterns of colors change in subtle ways—is a pleasurable way of exercising such skills. And aside from encouraging their aesthetic sensibilities, children can learn about the phenomenon of light interference. One interesting experiment is to make a film in a closed container and let it sit for an hour or so. The liquid will gradually evaporate, leaving a film that doesn't reflect any light. Nothing like this can be seen outside of a laboratory!

Underlying all these educational possibilities is the poetry of bubbles, which can provide philosophical insight into life itself. A bubble isn't a bubble if it lasts for a long time—part of its fascination is that you never know when it will pop. If you try to "capture" bubbles, by taking their picture or enclosing them in a bottle, you have a different kind of experience. Some of the best moments in life are like that. A festival, a play, a concert is exciting and wonderful partly because it is short-lived. The first moments of love, an intense conversation with a friend, the birth of a child are there and then gone. We can't hold on to them, even though many of us try. Blowing bubbles is a continual reminder that we would do well to savor those fleeting experiences.

Reforming Science Education

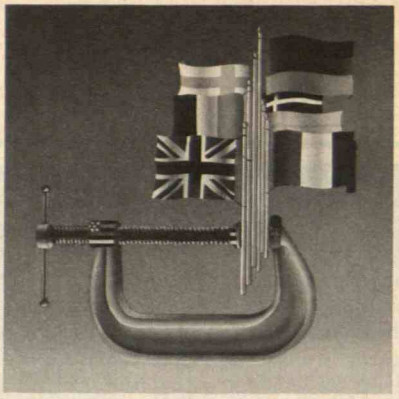
Now, I certainly encourage everyone to blow bubbles. But my greater concern is the education of children. Too much of their formal education is dull and rote—the learning of formulas and methods. Some of this is useful and necessary, but it often dominates the school day and most of the school year. Teachers often devote little time to the fascinating human-made and natural phenomena right around us. Exploration just for its own sake, and manipulation just because something is beautiful and fun, seem to be left at the school door.

For example, I once tried out some of my ideas in a suburban school system noted for its innovative and enlightened programs. In one school, the principal put me in a basement room more like a closet. Not only was it out of sight, but I suppose it was also out of smell: the odor of dishwashing soap tends to hang around, no matter how well one washes up afterward. And many of the teachers got curious looks on their faces whenever I talked about my "math" class.

But curiously, both teachers and parents look much more favorably on bubble blowing at the Children's Museum. Everybody is always very enthusiastic during special programs for visiting school children. And parents usually encourage their children to get involved, often asking how bubble blowing can be done at home. I have seen this happen with other "unconventional" educational activities—there is a tolerance for "frivolous" activities when done in the "proper" context. I think there is an important message here.

Recent years have seen a well-documented decline in student interest and abilities in science and mathematics—and this apparently starts early on. In one study, for example, nearly half the third-grade students interviewed said they did not want to take more science. Only a fifth of the eighth graders expressed a positive attitude toward science courses, and this percentage remained constant throughout high school. But the students said they liked science when they learned about it outside school—through museums, planetariums, "marine worlds," and the like. Maybe these places are onto something.

Perhaps schooling and play are incompatible, especially when it comes to playing with messy materials. If so, we ought to provide other opportunities for children to keep alive their fascination and wonder. After-school child-care programs offer such opportunities. However, I'm not convinced that education can't be more fun. The joy, as well as the learning, that I've seen come from blowing bubbles tells me that we need to reawaken the spirit and the energy that went into reforming schools in the 1960s. If we encourage a basic sense of play, the work of school will provide more lasting rewards. □



How to Win the Nuclear Arms Race: A View from Europe

BY SOLLY ZUCKERMAN

Negotiating for security, survival, and economic health is a far better strategy than risking the destruction of Western civilization.

Most Europeans who worry about nuclear weapons believe that there are already more than enough of them, but the American view—as perceived by these same Europeans—is that the West has too few. Similarly, while most informed Europeans are convinced that nuclear weapons are so destructive that their very existence deters armed conflict, they have come to believe that there is an influential war-fighting school of nuclear enthusiasts—not in Europe, but in the United States.

These easily stated antitheses, of course, obscure a great deal. Whatever the majority of American citizens feel about nuclear weapons, the United States has witnessed a remarkable and varied wave of antinuclear protest in 1982. Europeans can therefore now discern more than one American point of view. Nor is there a single European position. But it is fair to say that most Europeans still feel that their own views about nuclear weapons differ widely from those seemingly held by most Americans.

ILLUSTRATIONS: E. SALEM KRIEGER

While Europe Slept

In 1949, four years after the end of World War II and a year after the Soviet Union tried to isolate Berlin from Western Europe, the North Atlantic Treaty Organization (NATO) was created as a defensive alliance to deter any further Soviet move westward. At that time, only the United States possessed nuclear weapons, as well as a near-monopoly on information about their effects. Atomic and hydrogen bombs, some in the megaton range, soon became available for use by American air forces if war were to break out in Europe. In 1952, the United Kingdom became an independent nuclear power, and the Royal Air Force began arming itself with atomic bombs of British manufacture. A few years later, France achieved similar status.

As the number of nuclear weapons increased and so-called battlefield weapons came onto the scene, almost all the Western powers allowed them to be stockpiled on their soil. (Norway refused to have them except in wartime, and Canada later declared that its aircraft assigned to NATO would never carry nuclear bombs.) The conventional wisdom was that the destructive power of these new weapons could compensate for any weakness in Western nonnuclear forces compared with those of the Warsaw Pact. But apart from this belief, there was never—neither at the start nor later—a coherent NATO nuclear policy.

In 1957, U.S. Secretary of State John Foster Dulles pronounced the dictum, now associated with his name, of "massive nuclear retaliation" to any Soviet aggression. In turn, NATO authorities declared that the Western allies would not hesitate to be the first to use nuclear weapons, if necessary, to repel attack, an idea that later became part of the doctrine of "flexible response." This meant that any Soviet aggression would be countered at an appropriate level, and that nuclear weapons would be used if "conventional" arms were ineffective.

The Russians remained silent. Despite informally circulating statements that they would respond in kind to a nuclear attack (even though they believed that a nuclear exchange could not be contained, and that both sides would suffer grievously), the Soviets have kept whatever official plans they may have had for actually using their nuclear armory to themselves.

The horror that swept the world after Hiroshima and Nagasaki expended itself in declarations that all weapons of mass destruction should be banned, but this moral reaction had little, if any, effect on the nuclear arms race. The first effective antinuclear protest began in the mid-1950s, when many people realized that radioactive fallout from atmospheric nuclear tests constituted a serious and worldwide danger to health. Linus Pauling led a popular campaign in the United States to stop further testing. In the United Kingdom, Bertrand Russell, together with other well-known figures, launched the Campaign for Nuclear Disarmament, whose active supporters descended in an annual pilgrimage of protest on the U.K.'s only nuclear weapons establishment, at Aldermaston.

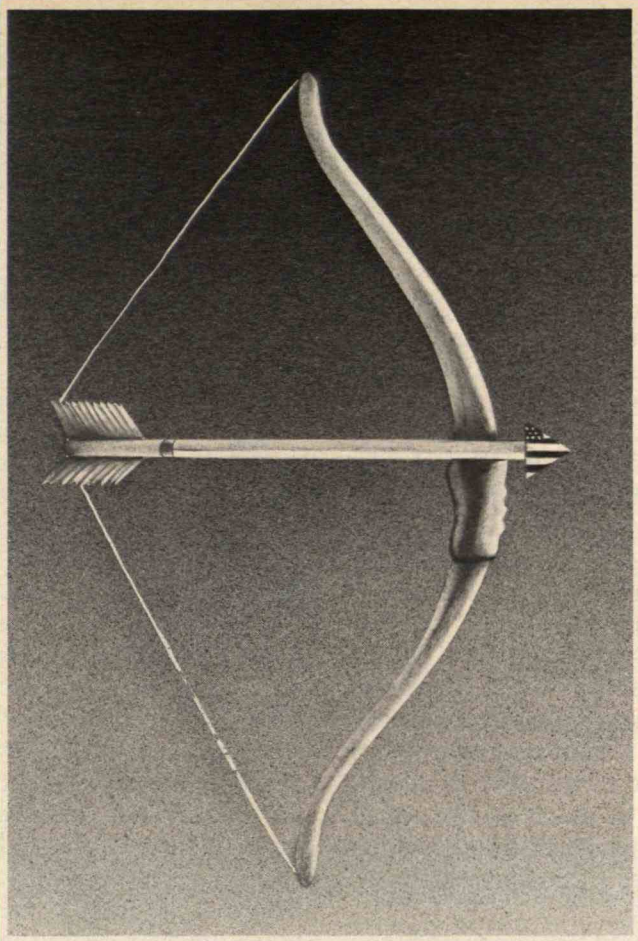
Public disquiet became so intense that governments had to take action. In 1963, after five years of negotiation, the United States, the Soviet Union, and the United Kingdom concluded the Partial Test Ban Treaty. Tests then continued, though underground. The failure to secure a *comprehensive* test ban—for tests below as well as above ground—was regretted more deeply in political circles in the United Kingdom, I believe, than in the United States. The British military establishment would not have protested, as would the American, had a total ban been agreed to. In any case, the antinuclear protest movement gradually died down.

For some time afterward, Europeans seemed little concerned about arms control. The Non-Proliferation Treaty of 1968, which succeeded a 1961 resolution of the U.S. General Assembly that called on all states "to conclude an international agreement to refrain from the transfer or acquisition of nuclear weapons," stimulated very little public interest. Although many Britishers may have thought that nuclear weapons were bad things, and that the fewer nations possessing them the better, there was little protest as the United Kingdom went on elaborating its nuclear arsenal, even if doing so was against the spirit of the treaty. Of course, the same could be said of the Americans, French, Russians, and Chinese. Indeed, not until 1975 did West Germany and Italy agree to adhere, and then only reluctantly, to the treaty. France, which seems to have little interest in nuclear arms-control agreements, has yet to endorse it.

Throughout the 1960s, most Europeans slept happily in the belief that Western Europe, with a host of other problems, was safe from war—the United States, after all, was committed to its defense. Vietnam and the Middle East were not only far away

but essentially the business of the superpowers. SALT I and the anti-ballistic missile (ABM) treaties of 1972 were also exclusively American-Soviet concerns, as was the Threshold Test Ban Treaty of 1974 and, most important, the still unratified SALT II agreement of 1979. Indeed, during most of the 1970s the British public seemed to have completely forgotten that in 1955, when the rubble of the Second World War had not yet been cleared away, its own government had taken some extremely strong positions in its Statement on Defense. According to the statement, if nuclear weapons were ever used in war, "They would cause destruction, both human and material, on an unprecedented scale. Large tracts would be devastated and many more rendered uninhabitable. Essential services and communications would suffer widespread interruption. In the target areas, central and local government would be put out of action partially or wholly. Industrial production, even where the plant and buildings remained, would be gravely affected by the disruption of power and water supplies and by the interruption of the normal complex interflow of materials and components. There would be serious problems of control, feeding, and shelter, public morale would be most severely tested, and it would be a struggle for survival of the grimmest kind."

Such a picture of nuclear devastation was both difficult and unpleasant to comprehend, and therefore something to which it was easy to shut one's eyes. The British public had also become bemused by the esoteric writings of armchair strategists, who had succeeded in making the issues of nuclear strategy absurdly mysterious and obscure. Most writers on the subject seemed to have no direct experience with war: by juggling numbers and acronyms, they were able to turn the reality of a nuclear exchange into a seemingly harmless video game.



Europeans tend to see the United States as the country that, more than any other, encourages the nuclear arms race—more so than the U.S.S.R.

Rude Awakenings

Two major issues have helped Europeans recognize the nuclear danger to Europe and form their own views on nuclear weapons policy. First, the oil crisis of 1973 revealed the precarious basis of much of the economic and social progress of NATO countries. Strains began to develop as the Federal Republic of Germany ("West Germany") thrived in comparison with the others. In fact, the second issue that helped spark the present wave of concern about Europe's future under NATO strategy was based on West Germany's special position within the alliance.

West Germany became a NATO member in 1955. In the preceding year, it had pledged never to manufacture nuclear, biological, or chemical weapons as a condition of its being a member of the Western European Union (WEU), a treaty organization that in 1954 took over from the earlier European Defense Community. The WEU itself became a somewhat dormant organization when the United Kingdom joined the European Economic Community (or "Common Market"). From then on, indeed beginning with the Berlin crisis of 1948-49, its leaders based the security of the republic on whatever it was that deterred the Soviet Union from moving westward—especially the protection of the American nuclear umbrella. But if war were ever to break out—according to NATO, only if the Russians

Armchair strategists, by juggling numbers and acronyms, were able to turn the reality of a nuclear exchange into a seemingly harmless video game.

attacked—West Germany was hopelessly exposed. It would be the main battlefield, the first where nuclear weapons would be used and the first to be devastated. This situation in no way changed when Chancellor Willy Brandt embarked on his own program of détente, the Ostpolitik. Nor were the Russians any less wary of what they saw as NATO's, particularly the United States', long-term aggressive intentions.

To reassure the Federal Republic that Washington would not unleash nuclear war at its sole discretion, the United States proposed creating a multinational nuclear force whereby West German sailors, together with those of other NATO states, would crew Polaris submarines. This plan foundered for a variety of reasons. The next reassurance was the formation in 1966 of the NATO Nuclear Planning Group, of which West Germany became a member: its finger, however nominally, was now as much on the trigger as that of any of its allies. Through this and another NATO committee, the alliance's "flexible response" policy was formed.

Other NATO countries seemed less concerned than West Germany about the dangers of nuclear war. There was no public protest in the United Kingdom, for example, when Robert McNamara, U.S. secretary of defense, declared that some 7,000 nuclear warheads for battlefield use had been deployed in Western Europe. Nor were many dissenting voices heard when there was talk of "clean" neutron bombs and small, "personalized" nuclear weapons (called Davy Crocketts) with which soldiers were to be armed.

Germany felt exposed not only because it would be the front line in a nuclear encounter, but also because both the United Kingdom and France were independent nuclear powers. Their nuclear forces were supposedly committed to NATO—at least, before General de Gaulle started to withdraw France from the alliance in 1964. But either Great Britain or France, if its government deemed such action to be in its national interest, could withdraw its forces to operate independently.

Under these circumstances, one can appreciate the continuing concerns of Germany and the other nonnuclear members of the Western alliance. Their existence, in effect, is at the mercy of decisions in which they would play no part. This did not seem to matter in the early days of NATO, when the United States had a powerful lead in nuclear weaponry deemed sufficient to deter the Soviet Union from any move west of the "Iron Curtain." But it certainly did matter once the Soviet Union had built up its own nuclear armory and the concept of nuclear superiority ceased to have any meaning.

In 1977, disquiet among European members of NATO was brought into sharper focus when a speech by West German Chancellor Helmut Schmidt touched on the question of whether the SALT agreements between the United States and the Soviet Union might jeopardize NATO's defense strategy. As he put it, when the SALT negotiations opened, "We Europeans did not have a clear-enough view of the close connection between parity of strategic weapons on the one hand and tactical nuclear weapons on the other." (The concept of a separate class of "theatre nuclear weapons"—as oppposed to long-range, strategic weapons—had not yet become common currency.) Then, after reference to the fact that delegates at the ten-year-old Mutual Balanced Force Reductions talks in Vienna had failed to make any real progress, he uttered the sentence that reopened the entire nuclear debate in Europe. "We have to consider," he said, "whether the 'neutron weapon' is of value to the alliance as an additional element of the deterrence strategy, as a means of preventing war."

We've Got More Bombs

The American response to this seemingly innocent remark was immediate: if its NATO partners wanted any further reassurance about the American commitment to their defense, the United States was only too ready to oblige. Until then, neutron warheads had not been considered to be distinct from any other kind of nuclear weapons, and the average European had never heard of them before, but they were there for the asking. And to counter the Soviet Union's increasing nuclear threat—particularly the new mobile SS-20, whose deployment had started in 1977—other American weapons were available too: cruise missiles and the unproved short-range ballistic missile, the Pershing II.

The European members of NATO not only had to respond to these offers but to accustom themselves to the new concept of theatre nuclear weapons. That idea may have made sense to Americans but it made little sense to the Russians and to those Europeans who saw in it a warning that under some circumstances Europe might be on its own in a nuclear war.

Jimmy Carter was then in the White House. He

Twentieth Century Limited

by Art Buchwald

I can't tell you where the Limited Nuclear War Room is in Washington, but I can assure you that everyone there is working very hard.

Wakko, whose book, *Nuclear War–Keep It Small, Keep It Simple*, is must reading for defense planners, said the idea of a "limited nuclear war," or LNW as it is referred to in inner circles, is now catching on with more and more people who once felt nuclear war was unthinkable.

"According to our feasibility studies," he told me, "it is now possible to fight a limited nuclear war with minimal damage to the U.S. and the Soviet Union."

"Where?" I asked.

"Luxembourg. The terrain is excellent and the population is small. If both sides can contain it there, we won't get much fallout from the rest of the NATO countries. What do you think?"

"I'm no expert on LNW," I said, "but I don't see how we could keep it limited to just Luxembourg."

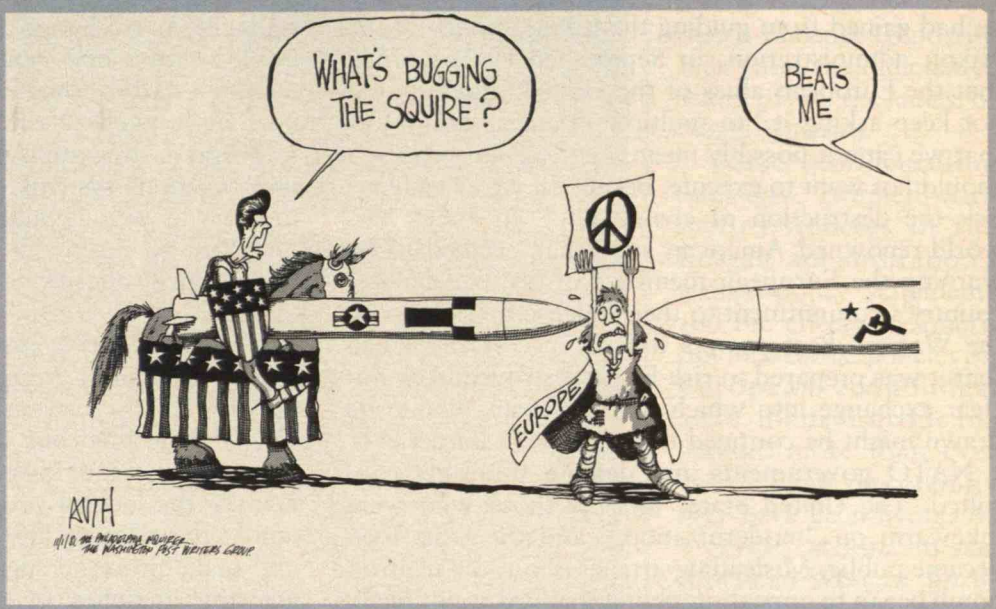
"If it does spill over, we're prepared to fight in Switzerland."

"I thought Switzerland was neutral."

"It is, but we can't do anything about the prevailing winds. If they're blowing that way, we may have to write off Geneva."

"I'm sorry to hear that. I was always fond of Geneva."

"Well, it's either Geneva or Paris, and we want to do everything in our power to spare Paris, if we possibly can."



"How come?"

"We were planning to set up our LNW headquarters there. Our generals prefer the hotels over Brussels."

"What guarantees do you have in an LNW that Paris won't be nuked?"

"We've told the Soviets if they zapped Paris, then we would nuke East Berlin."

"What about London?"

"We can't guarantee every European city in a limited nuclear war any more than the Russians can. But the object is to keep the fighting to the smaller towns, which won't be missed."

"I hope you can spare Rome and Florence," I said.

"I'm sure we can save Rome, but I can't give you any guarantees on Florence. If the Soviets come up from the south we're going to have to stop them somewhere."

"Have you written off Stockholm and Copenhagen if they attack from the north?"

"The Kremlin is aware that if they flatten Stockholm and Copenhagen, we'll wipe out Budapest and Warsaw. You see, the beauty of limited nuclear war is that both sides can pick their targets, and if they overstep them, they know the other side will retaliate. For example, if the Soviets radiate Amsterdam, then we'll clobber Prague, and if they decide to destroy Lisbon, we'll hit Bucharest. This could lead to a major confrontation between the superpowers, and we don't think the Soviets want that."

"As long as you believe an LNW can just be kept to the smaller towns in Europe, I don't see why any sane person would be against it," I said.

"We're getting some opposition from Europe, but we think it's being stirred up by the Communists. One of our jobs is to persuade our friends on the continent that a limited nuclear war is in their best interests, even if it has to be fought on their soil."

"Better Madrid than Miami," I said.

"Well," Wakko said, "I've got to go back to work. We're war gaming an LNW in Monaco." □

had started out as a firm believer in the need to curb the nuclear arms race, and he wanted to see the SALT II agreement ratified, achieve a comprehensive test ban, and halt the proliferation of nuclear weapons. But he did not enjoy enough political support to bring a single one of these aims to fruition. Nor did the Soviet invasion of Afghanistan help. Even though deploying new nuclear weapons systems could hardly have been in his mind at the beginning of his presidency, by 1978 he was ready to take action on Helmut Schmidt's suggestions.

As if to urge the European members of NATO to accept the American offer to "modernize" NATO's nuclear armory, Henry Kissinger, with all the gravity

ILLUSTRATION: AUTH, THE PHILADELPHIA INQUIRER, AND THE WASHINGTON POST WRITERS GROUP

he had gained from guiding the foreign policy of the Nixon administration, in September 1979 warned that the European allies of the United States should not keep asking it "to multiply strategic assurances that we cannot possibly mean, or if we do mean, we should not want to execute, because if we execute we risk the destruction of civilization." In effect, this world-renowned American statesman seemed to be warning the European members of NATO that his country's commitment to their defense in a war with the Warsaw Pact powers did not necessarily mean that it was prepared to risk being destroyed. Any nuclear exchange into which the Europeans would be drawn might be confined to a European battlefield.

NATO governments and defense ministers consulted. The United States lobbied those who were lukewarm on "modernization," and the issue then became public. Misleading articles about the neutron bomb began to appear, implying that it was not really a nuclear weapon but a new device specially designed to stop an armored thrust by the Russians. It would presumably kill tank crews without damaging the vehicles or nearby structures. A section of the public, mainly on the left, reacted: here was a true capitalist's weapon, something that destroyed life but preserved property.

Few remembered how little protest there had been in the late 1950s and early 1960s when American missiles, the Thor and the Jupiter, had been stationed on European soil. They had forgotten that in those days the Royal Air Force had deployed an air-launched cruise missile called Blue Steel. The public saw American cruise missiles as somehow different—if planted near one's backyard, they were sure to invite reprisal. Areas presumed not to be targets for possible Soviet nuclear attack would become targets. It was not long before the dissent increased and crossed party lines. No longer could it be called a protest that emanated only from a pro-Soviet left.

Enthusiasm for the American proposals varied among the governments of the NATO countries. The United Kingdom was the least opposed, while Holland and Norway were the most. But in 1979, little more than a year after Helmut Schmidt's speech, NATO ministers at a meeting in Brussels agreed to accept the American offer of cruise and Pershing II missiles on the following condition: that before they were deployed, negotiations should be opened with the Russians for reducing their planned force of SS-20s (and the older missiles they were designed to replace) in exchange for limiting deployment of NATO's two new nuclear systems. These negotiations—called the Theatre Weapon or Intermediate-Range Nuclear Forces (INF) talks—are now in progress. But opposition to the stationing of the new weapons systems continues to grow in parliamentary as well as public circles.

Ambitious Proposals

In December 1980, just before Ronald Reagan became president, a group of prominent political leaders unofficially convened under the chairmanship of Olof Palme, then out of office but now once again prime minister of Sweden. This group set out to analyze the lack of progress on arms control, reexamine the relationship of arms control to security, and make practical suggestions that might allay the growing anxieties of ordinary people everywhere about possible nuclear war. The group included David Owen, foreign secretary in former British Prime Minister James Callaghan's Labor administration; Gro Brundtland, former prime minister of Norway; Joop den Uyl, deputy prime minister (and formerly prime minister) of Holland; Cyrus Vance, one-time deputy secretary of defense and for three years secretary of state to President Carter; and politicians from other countries, including a Soviet official and representatives of the Third World.

The commission's report, animated by the belief that "a doctrine of common security must replace the present expedient of deterrence through armaments," and that "international peace must rest on a commitment to joint survival rather than a threat of mutual destruction," appeared in time for the opening of the United Nations Second Special Session on Disarmament in June 1982.

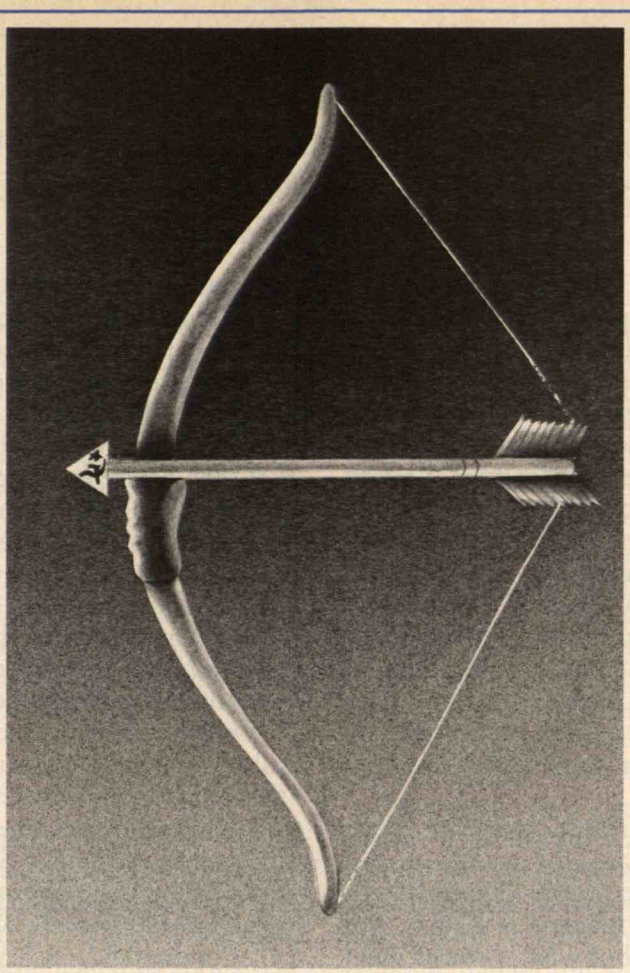
The Palme report includes a program of action divided into short-term and medium-term measures. The former includes ratification of the 1979 SALT II treaty, preservation of the ABM treaty of 1972, establishment of battlefield-weapon-free zones in central Europe, and a comprehensive test ban. Medium-term measures include a U.S.-Soviet agreement to reduce strategic offensive forces substantially, and equal ceilings, below current levels, for NATO and Warsaw Pact conventional forces in central Europe. These are certainly ambitious proposals, but they have been put forward by experienced world leaders who harbor no illusions. These leaders do not expect an instant re-

sponse, but they are convinced that if international, particularly East-West relations, continue on their present course, the end can only be disaster. Unfortunately, the U.N. Special Session made no practical use of the Palme Report's recommendations, nor could the session agree on any of its own.

Tough Talk in Washington

From the moment that Ronald Reagan moved into the White House in 1981, he added fuel to the fires started by the European antinuclear movement. His vehement anti-Soviet pronouncements, their implications of imminent war, and the impression that he and his staff saw Europe as a potential nuclear battlefield—with the United States immune from attack—began to unsettle wide sections of the European public. The leak to the *New York Times*, on the eve of the abortive U.N. session on disarmament, of a lengthy Pentagon document setting out so-called guidelines for "protracted nuclear war" exacerbated European fears. American officials seemed to be turning the clock back to the 1950s—even earlier—with talk of using nuclear weapons to render ineffective the whole of the Soviet political and military system.

Nor have European worries been lightened by other startling pronouncements from the Reagan administration: that a nuclear war can be fought and won, and that the United States could recover in two or three years from an all-out nuclear exchange with the Soviet Union (which could result in something like 100 million American deaths). The message of the new administration seemed to be that Americans could rely on their national ingenuity to survive—that a phoenix could rise even from the radioactive ashes of all the cities of North America.



Apart from a few on the far left, most Europeans still see the Soviet Union as their only potential enemy.

These bloodcurdling messages, coupled with inconsistencies in the Reagan administration's foreign-policy statements and the effects of American monetarist policies on European economies, have made Europeans realize, more than ever before, how precariously they have been living. As a result, strains in the American-Western European relationship are beginning to show. Moreover, Washington's obstinate arm-twisting to discourage Western Europe from investing in the new Soviet gas pipeline has not helped, nor has America's opposition to the proposed Sea-Bed Treaty. Europeans see a trade war opening up between the United States and its NATO allies.

Despite the economic pressure the United States is exerting on Western European countries, despite the fact that there is talk in Washington of nuclear war, and despite all the issues that are now adding a new dimension to the urgent anxieties of Europeans, I do not believe that the United States has yet shaken the faith of its European friends in the need for the Western alliance. And it would be incorrect to say that public concern in Europe about the bomb is causing a new wave of anti-Americanism. Apart from a few on the far left, most Europeans still see the Soviet Union as their only potential enemy. The move into Afghanistan, for example, was seen as a sign of continuing Soviet expansionist policies. And the suppression of the Solidarity forces in Poland by a military dictatorship—underwritten by the Russians—is still regarded as a mark of the Soviet contempt for the

Neither side should demand verification of the unverifiable; both should negotiate toward the common interests of security and survival.

ideals of Western democracy. Europeans still recognize that their status quo depends on NATO, and they are all for an adequate defense.

But they don't want the bomb. It is becoming clear, to people in the street and "experts" alike, that nuclear war would very likely mean the end of Europe. They fear that the United States may lead the Western world into a nuclear war that could destroy the Soviet Union and Europe while leaving the United States untouched. This is what Europeans are basically protesting against today, not as in the 1950s and early 1960s, when they were primarily concerned about the health effects of radioactive fallout. Whether or not the new view is justified, Europeans tend to see the United States as the country that, more than any other, encourages the nuclear arms race—more so even than the Soviet Union.

Norway, with a common frontier with the Soviet Union, has feared the Russians for centuries. But today it is more fearful of the bomb. The people of Holland and Belgium know what it is like to live under the boot of an invader, but what disturbs them far more than memories are the belligerent noises from the United States since Reagan assumed power. Nor does Germany want to be destroyed. When Helmut Schmidt noted in 1977 that the reunification of Germany continued to be a major goal, he also observed that "the German question cannot, and must not, have priority over peace." A better-informed public realizes that any war in which nuclear weapons were used would make all "causes" irrelevant.

Faith, Hope, and Reason

We must remember that it took the Partial Test Ban Treaty of 1963 to bring about the virtual end of the antinuclear movement of the 1950s and early 1960s. Similarly, today's protests—which span the whole political spectrum—are unlikely to subside unless some positive results emerge, and quickly, from the U.S.-Soviet negotiations on "theatre" nuclear weapons begun in Geneva at the end of 1981, or from the Strategic Arms Reduction Treaty (START) talks on intercontinental weapons systems that have recently started. And only if far-reaching agreements are concluded in the talks—that is, only if some of the recommendations of the Palme commission are fulfilled—will the spirit of the protest be satisfied.

But the realist knows that little good is likely to come out of either set of talks unless both sides negotiate in good faith toward the same objective. Separating the two sets of negotiations artificially—as if they concerned very different weapons systems—will give rise to difficulties. So will the fact that no European NATO member is at the negotiating table.

The main trouble with arms-control negotiations is that they have become as arcane as the theorizing of armchair strategists about how to conduct a nuclear war. We are told, for example, that a "principle of parity" must govern the outcome. But isn't parity meaningless when both sides possess nuclear arsenals already vastly greater than necessary for mutual deterrence? As it is, both could sacrifice much hardware without endangering their security.

We are told that there is a linkage between so-called strategic nuclear systems on the one hand (those that can strike across the Atlantic) and theatre and battlefield weapons on the other. But what is strategic to the United States is not the same as what is strategic to the Soviet Union, the European members of NATO, or the Warsaw Pact allies. A few so-called battlefield nuclear weapons could utterly devastate Holland, Belgium, or Czechoslovakia. Would they be strategic? The Soviet SS-20, a pretargeted, so-called theatre weapon, could not reach the United States but could wipe out any European city. Is it not a strategic weapon? The cruise missile and the Pershing II, like the United Kingdom's Polaris missiles today, would be pretargeted against Soviet cities. Does the Soviet Union see them as strategic or tactical weapons? There is nothing to stop the Russians from aiming strategic weapons now believed to be targeted against the United States at European cities. Are they to be counted as both strategic and theatre?

The American Trident missile is being treated as a strategic weapon in the START talks, but, according to current British policy, those that the United States has agreed to supply the United Kingdom will not enter the strategic parity argument. Every bit as curious is the intention that the British Trident missile should not even count in *any* equations of so-called parity. The nonnuclear members of NATO have silently accepted over the years the paradoxical notion that the United Kingdom's nuclear arsenal can be independent while also assigned to NATO. But the Russians have now declared publicly that in counting up the launchers, warheads, and yields—their own as well as all those poised against them—they have not forgotten the ones in British and French arsenals.

The U.S.-Soviet talks will undoubtedly get bogged

Europeans still recognize that their status quo depends on NATO. And they are all for an adequate defense. But they don't want the bomb.

down in the effort to sort out these and other irrationalities. Negotiators will succeed only if they do not forget their primary purpose—the need to reduce the danger of war while maintaining military security for both sides. Obviously, neither superstate will reduce the size and composition of its nuclear arsenal to the point where its opponent would be able to threaten the use of its nuclear weapons. But all military reason has been lost in the numbers game that the two sides have now been playing for more than a decade. Rather than reopen sterile arguments about irrelevant numbers, the immediate purpose of the negotiations must be to reduce the danger of war in the Western world.

Never Fear to Negotiate

Of course, no responsible military commander would advise his political leaders to use armed force if doing so carried the risk of a nuclear exchange. Nor, one can hope, would political leaders stake their fortunes on a belief that their highly complicated weapons systems would operate perfectly. Computer, radar, and other sensor systems have already given scores of false alarms of attack and are likely to go on giving them. But if the Pershing II system is installed—assuming it is ever perfected—and a missile goes off, the Russians would have only a few minutes' warning that Soviet soil was about to be hit by Western nuclear warheads. An exchange of words on the hot line, to determine whether the strike is an accident or "for real," would be out of the question. There simply wouldn't be enough time. Although this is not a new situation—a Polaris missile fired by accident would also leave little time for an exchange of messages—Pershing II underlines the danger of an automatic response to an automatic firing. The Soviet Union might be driven, in other words, to a strategy of "launch on warning."

This situation is the most ironical of all the fruits of human ingenuity: human judgment could be renounced in favor of mechanical judgment in matters that affect human survival. All, not only the European, members of NATO have blindly accepted this for years, but their sophistication has grown rapidly as the handwriting on the wall has become clearer. The United States and Soviet Union must therefore carefully consider the several European proposals for nuclear-free zones advanced in recent years, as well as the idea of withdrawing battlefield nuclear weapons from NATO and Warsaw Pact countries alike. Neither side should demand verification of the unverifiable, and both should negotiate toward the common interests of security and survival.

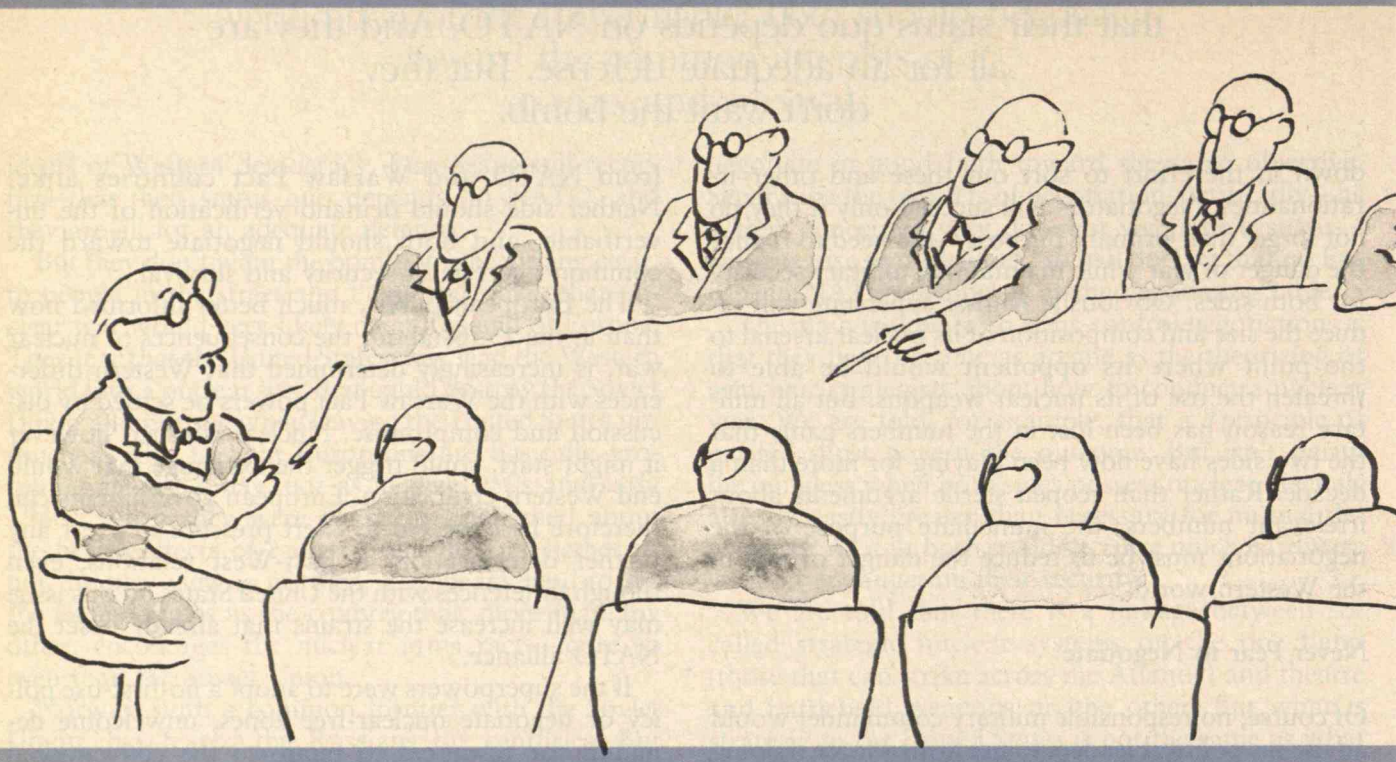
The European public, much better informed now than in the 1950s about the consequences of nuclear war, is increasingly determined that Western differences with the Warsaw Pact powers be settled by discussion and compromise. Nuclear conflict, however it might start, could trigger the exchange that would end Western civilization. European governments can therefore be expected to exert pressure to avert any further deterioration in East-West relations, even though differences with the United States on this issue may well increase the strains that already beset the NATO alliance.

If the superpowers were to adopt a no-first-use policy or negotiate nuclear-free zones, unwelcome demands for resources to reinforce the conventional strength of the West are certain to arise. But the basic problem of holding NATO together may well become unmanageable if the United States continues to pursue too belligerent an approach to East-West relations. Although the United States came to Europe's aid after the Second World War—both with the Marshall Plan and by underwriting NATO—it cannot expect its NATO allies to commit themselves to an irrational and pretentious crusade against the social and economic system of the Warsaw Pact countries. American leaders must realize that the European members of NATO have as many reasons to cooperate economically with the USSR and its allies as they have for being wary of its ideological doctrines.

Europe does not want war. Winston Churchill once wrote that "the statesman who yields to war fever must realize that once the signal is given, he is no longer the maker of policy but the slave of unforeseeable and uncontrollable events. Always remember, however sure you are that you can easily win, that there would not be a war if the other man did not think that he also had a chance."

But this was before the emergence of the atom bomb. We now live in a world of nuclear weapons, and we cannot cause the knowledge of how to make them disappear. But we know what would happen to the civilized world were these weapons ever to be used—neither side would stand a chance.

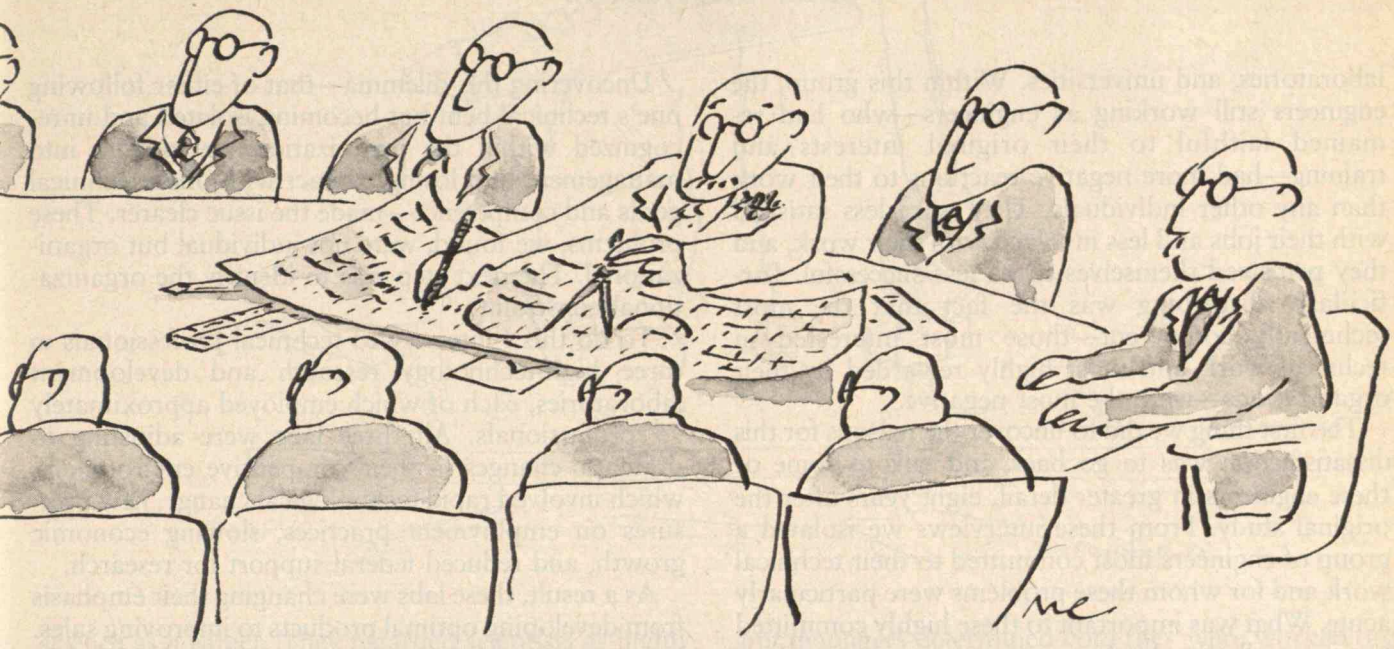
LORD ZUCKERMAN is the former chief scientific advisor to British cabinets, prime ministers, and the Ministry of Defense. His most recent book is *Nuclear Illusion and Reality* (Viking, 1982).



Resolving Contradictions in Technical Careers

OR

What if I Like Being an Engineer?



Engineers often regard entering management as the only way to enhance salary and status. But many are deeply committed to the technical work they were trained for. To deal with this dilemma, industry must rethink the character of technical careers.

BY LOTTE BAILYN

LESS than a decade ago, engineers were being laid off in large numbers. Today the United States is faced with a "shortage" of engineers. Companies vie for the best engineering graduates and lure the engineering faculty needed to train new engineers away from universities. But companies are also expressing their growing concern over the many older engineers who seem to be stagnating. Thus, the apparent shortage of technical personnel may result as much from the low productivity of older engineers as from a lack of new ones. Complicating this is the complaint voiced by many young engineers that they have few role models of career engineers. The solution to the perceived shortage, therefore, depends as much on better management of mature technical professionals as on recruitment and training of new ones.

My research on this problem began in 1970 with a study of M.I.T. alumni 10 to 20 years into their careers. This group of highly trained scientists and engineers worked in a variety of positions in private industry, nonprofit

ILLUSTRATIONS: MICHAEL CRAWFORD

The engineers who had remained faithful to their original interests and training had more negative reactions to their work than any other individuals.

laboratories, and universities. Within this group, the engineers still working as engineers—who had remained faithful to their original interests and training—had more negative reactions to their work than any other individuals. They were less satisfied with their jobs and less involved with their work, and they perceived themselves to be less successful. Particularly disturbing was the fact that the most technically competent—those most interested in technical work and most highly rewarded by their organizations—were the most negative.

The first thing we did to uncover the reasons for this dissatisfaction was to go back and talk to some of these engineers in greater detail, eight years after the original study. From these interviews we isolated a group of engineers most committed to their technical work and for whom these problems were particularly acute. What was important to these highly committed but especially troubled engineers was to be involved in the solution of technical puzzles. Like jigsaw or crossword puzzles, these puzzles have a solution, the procedures for solving them are known to the person working on them, and there is fairly immediate feedback on whether the worker is on the right track.

These attributes are of critical importance to individuals in this group because work of this sort is essential to their feelings of competence and self-worth. As one engineer put it, "In engineering you are quickly calibrated or evaluated. You can measure the efficiency of a product, and this gives you an evaluation of your own success or failure . . . In some professions you never know whether you succeed or fail. You can convince yourself, but you never have solid proof whether you have done well. That's the advantage of hard-core engineering."

And yet, this same person said he wishes he had not become an engineer. What happened, it seems, was that he could not find a position in his organization in which he could grow, gain recognition, and still retain the involvement with technical puzzles that meant so much to him. His solution was a compromise, and a risky one. He opted for the role of "internal consultant"—becoming his company's sole authority in a very specialized area. It met his need to solve technical problems, but it left him isolated and quite vulnerable to technological change. We found that others in the same situation made the opposite choice. They worked their way into management, giving up the satisfaction derived from technical work in exchange for more status, recognition, and pay.

Uncovering this dilemma—that of either following one's technical bent but becoming isolated and unrecognized within the organization, or moving into management and losing contact with one's technical goals and competence—made the issue clearer. These problems, we found, were not individual but organizational. The next step was to identify the organizational constraints.

To do this I interviewed technical professionals in three high-technology research and development laboratories, each of which employed approximately 75 professionals. All three labs were adjusting to dramatic changes in their competitive environment, which involved rapid technological change, new pressures on employment practices, slowing economic growth, and reduced federal support for research.

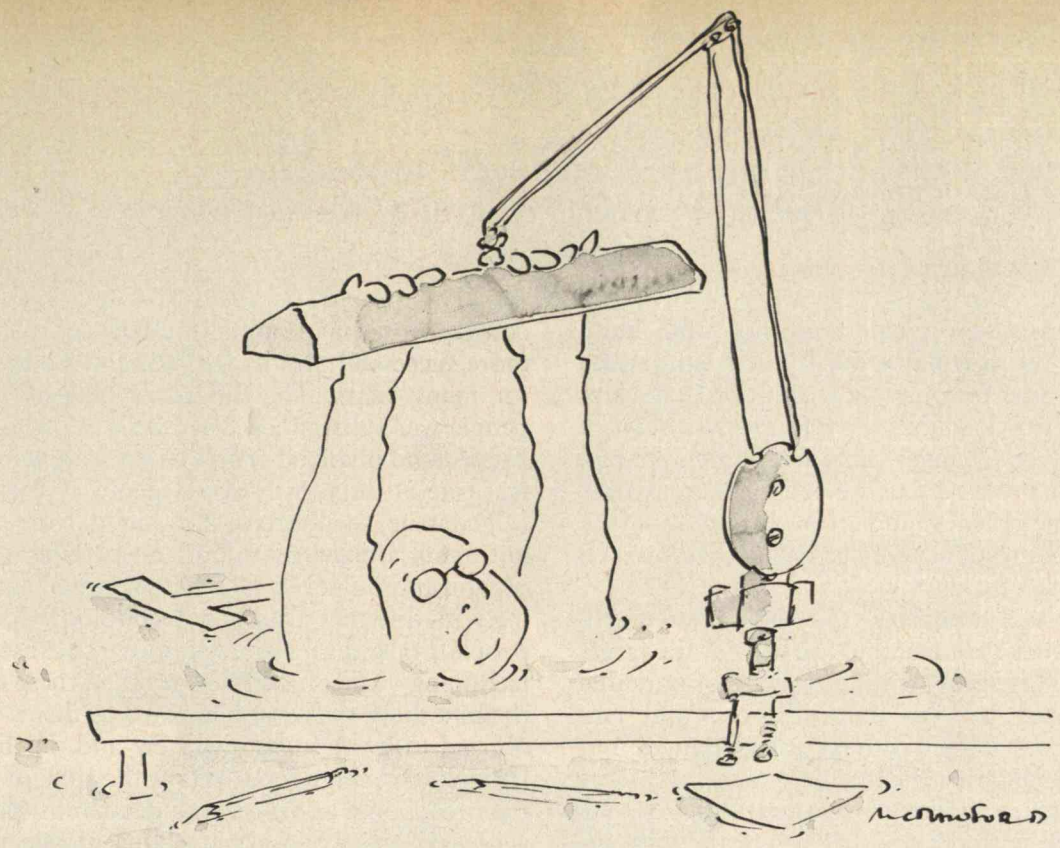
As a result, these labs were changing their emphasis from developing optimal products to improving sales. Using existing technology (or working "within the art") rather than developing new technology (or working at the "cutting edge") was encouraged. The cycle from research to development to production, with people at each stage working more or less independently, no longer fit. It was now necessary to make a direct transfer of technology from research to production, and to forge much closer links between development and manufacturing.

Such changes affect the very essence of an organization, including the time scale within which work is done, the criteria for success, and how employees are perceived in relation to the organization's mission. What was required was a cultural change, a term used by the participants with whom I talked.

I found that the process of adapting to these new conditions created four contradictions that interfered with the efficiency of work and career satisfaction. These contradictions are not the result of ill will, irrational behavior, or any lack of intelligence on the part of management, but stem from complexities of growth, development, and change. They probably occur in many R&D settings, and recognizing them is important to all managers of technical professionals. They give specific meaning to the career frustrations originally identified in the M.I.T. sample.

Autonomy and Control

The managers I talked to, particularly those in the lab with the most scientists (as opposed to engineers), had a very definite view of what it means to pursue



science as a career. They regarded scientists as highly intelligent people for whom work brings its own rewards. Many organizational procedures were based on this assumption, particularly those in recruitment, promotion, and training. And it led managers to create an atmosphere conducive to creative work in which professionals were given as much autonomy as possible in choosing problems, as long as their work related to the overall goals of the organization.

But in the rapidly changing circumstances of these labs, what was and wasn't related to the organization's goals wasn't always clear. Besides, the scientists said, had they wanted this kind of autonomy they would have worked in a university. As one physicist told me, coming to an industrial lab was a difficult decision, but once made, it solidified his desire to use knowledge and skills in the pursuit of organizational goals. He resented the fact that he was encouraged to work on problems that did not fully meet this criterion. These scientists clearly considered themselves different from the sterotypical scholar-scientist on this point. What they wanted were well-defined projects central to the company's mission. And once given a relevant task, they expected to be given the resources, independence, and discretion to complete it.

Yet, it was often just at the point of implementation that the organization stepped in with controls: managers had to consent to even small equipment purchases; group leaders had to approve technical memos; papers carried names of supervisory personnel not involved in the work being reported. Researchers could choose which problems to work on, but managers determined *how* they were worked on. It should have been exactly the reverse.

I am reminded of a study on the differences between parental attitudes toward adolescents in suburban America and in Denmark. Danish parents kept their children closely in check during childhood. By the time the children reached adolescence, they were assumed to have internalized parental values and were let loose on the world. American parents showed exactly the opposite pattern: they were overly permissive in the early years, and they attempted to institute controls during adolescence if things went too far. The American approach was not as successful as the Danish one, according to the study. The organizations I studied followed the American pattern, but the professionals knew that their work would be more effective and their careers more satisfactory with an approach closer to that of the Danish. What managers thought motivated their people did not coincide with reality. As a result, some of these laboratories' most highly qualified personnel were frustrated and disappointed, and hence less able to produce effectively.

Reorganization: A Rational Response?

A second contradiction stems not from managerial myths, but from a common and seemingly rational response to change: the impulse to reorganize. In the face of new external constraints, organizations often remove common functions from divisions or project groups and centralize them into new departments.

What these engineers wanted were well-defined projects central to the company's mission.

But such changes may create confusion and inefficiency within the original groups. Such reorganization was a continuous source of frustration in the labs I studied—it clearly reduced the effectiveness of work at the group level. Changes came with little apparent reason, and the professionals viewed them as creating unnecessary inefficiency and even chaos. In many cases, employees responded by reducing their own efforts to increase efficiency.

There may be a necessary trade-off between efficiency in the work group and at the level of the larger organization. Managers should be aware of potential problems caused by this contradiction, and employees should be warned of impending changes. But better communication may not be enough. In some cases, seemingly rational reorganization may seriously interfere with the productivity of the total organization.

What can be done to alleviate the consequences of these contradictions in any given organization will depend, of course, on particular circumstances. But the first step is to recognize contradictions and work with the relevant people on resolving them.

Movement versus Stagnation

The third contradiction involves the problem of stagnation. The U.S. workforce is aging, and with government laws prohibiting age discrimination the problems of the "mature professional" have become prominent. Nonetheless, our society continues to idealize youth. While the organizations I studied did promote people after 40 and employ independent contributors in their fifties and sixties, the perception of the technical employees was otherwise. One reason for this was that groups tended to be fairly homogeneous in age. This fact suggests at least a superficial remedy: integrating different ages within work groups. In many studies of aging, such a solution has been shown to increase the effectiveness and adaptability of older and younger workers alike.

But stagnation, and not chronological age per se, is at the heart of the issue. Everyone I talked to, from technicians to top managers, feared being stuck in one job "too long"—a period usually defined as ten years. The effects of stagnation were brought home to me by two group leaders of the same age, both with long service to the company. The first had just become a group leader. The second had been made a group leader after only three years of service and, consequently, had initially been considered much more successful. But he had remained a group leader for many years. The difference between these two people was substantial. The first was one of the most excited and involved people in my sample; the second was one of the most discouraged.

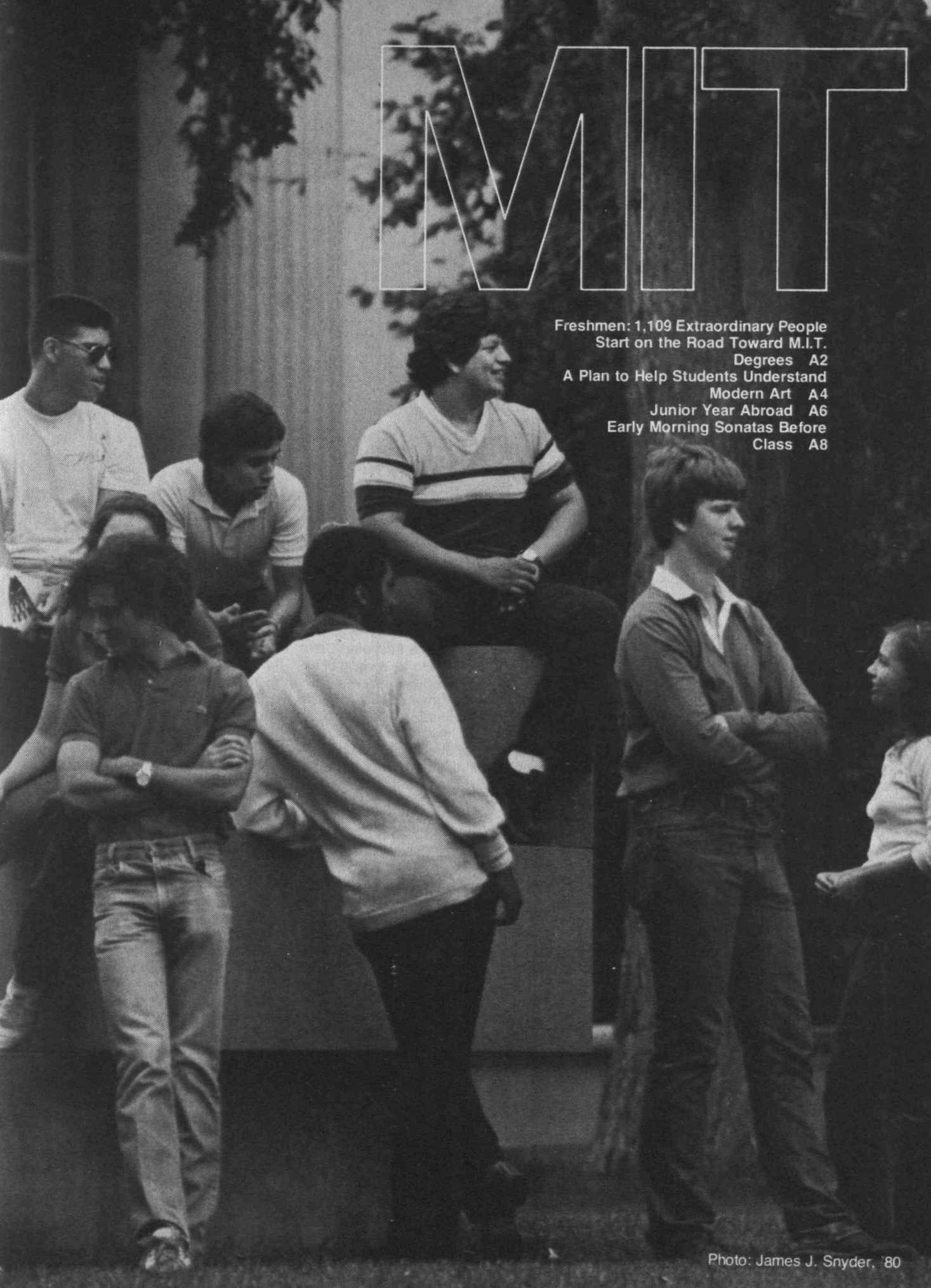
The issue, therefore, is movement. Movement need not entail a promotion, but can be lateral within an organization or even to different organizations dealing with different aspects of technology. A number of people I talked to, forced to move because a specific technology was phased out, recalled these changes as the best thing that ever happened to them. They were obliged to learn something new and, in the process, had avoided stagnation. But at the time of the move, their reaction was different. Indeed, most people were very cautious when asked about prospective movement.

And herein lies the contradiction. Movement is seen as beneficial by both managers and professionals, but both also fear it. Managers fear the loss of their group's best people and employees worry that they will not be able to learn the new technology—that during a period of retooling they will lose their ranking and their salaries will suffer. Again, recognition of the problem is a key to its resolution. But inertia is strong, and sustained support on both sides is required to overcome it.

Productivity versus Promotion

The final contradiction is that between work and career—between an emphasis on productivity and a concern for promotion. Many people assume that work and career go together, but in fact, in the organizations I looked at, they seemed to be in conflict. Career advancement requires being visible to management, but effective work requires involvement and responsibility at the nonsupervisory level.

As illustration of this contradiction, consider the actual case of a customer who has a complaint about a system. Typically she approaches the systems engineer, with whom she agreed on the original design. The systems engineer recognizes the problem as one of development. At this point two scenarios are possible, one emphasizing work, the other, career. The work scenario has the systems engineer, the developer, and the customer sitting down together to diagnose the problem. After some deliberation, the issue is resolved, the customer is pleased, and the de-



MIT

Photo: James J. Snyder, '80

1,109 Extraordinary People Start on the Road Toward M.I.T. Degrees

Photo previous page: *Waiting to begin. Having eaten their fill of roast beef and watermelon, members of the new Class of 1986 wait in Killian Court on August 27 for the president to speak and then the famous call: "Let the rush begin!"*

The unusual was usual—as usual—in Cambridge last fall. The freshman Class of 1986 is turning out to be a class of extraordinary young people.

Consider for example Jene Marlene Spears, '86, of Detroit, made famous in *Black Enterprise* magazine for her contributions to solar energy technology as a high schoool student; she was one of 40 winners of a Westinghouse Science Talent Search and a winner of the 1980 NAACP Science Contest. . . . And Lisa Howard, '86, the first student ever to enter M.I.T. from the special science and mathematics program at Ballou High School, Washington, D.C.; she is the first member of her family ever to go to college, the winner of eight sports trophies in basketball, softball, and volleyball, and she wants to study aeronautics and astronautics in preparation for a career as an astronaut—"I just thought this would be the funnest thing in the world," she says.

One member of the class is a three-time winner of a state science fair. There are a state debating champion and a gold medalist in Russian. One student is marketing his own computer game. There are a nationally ranked diver and sailor, a co-ed who was captain of her high school *foot*ball team, a highly ranked tai kwon do performer. One member of the class has soloed on the piano in Carnegie Hall; there are a winning classical guitarist and an all-state trumpeter who has been honored as a musician in Vienna. And Miss National Teenager 1981 is a member of the class, too.

Total freshman enrollment is 1,109—including 264 women. Peter H. Richardson, '48, director of admissions, had an original goal of between 1,075 and 1,100. But in the summer of 1982 the "yield"—the proportion of students who accept M.I.T.'s offer of admission—went up four percentage points from 1981 to 58 percent, and for a while at the end of August there were some dreary estimates: as many as 1,141 freshmen and serious overcrowding in the dormitories.

There were 415 vacancies in the fraternities, all filled during the three-day rush period at the beginning of orientation—an "extremely smooth" rush week, said Mark Sorrells, '83, the IFC's rush chairman.

"The Most Compelling Goal of Our Time"

Everyone has advice for the new arrivals—so much that a whole week of orientation was required to deliver it all. Jerri-Lynn Scofield, '82, editor-in-chief of *The Tech*, noted in the mid-summer issue that "many students are terrified, usually unjustly, by the prospect of entering such a vibrant, high-powered intellectual environment." Her advice: "The secret to getting the most from time here is iden-

Wearing his "Institute Gray" shirt, President Paul E. Gray, '54, welcomes members of the Class of 1986 at the traditional picnic in Killian Court on August 26. Beside him, "The Boss"—Mrs. Priscilla Gray—shares an event which is one of the most optimistic and informal of the academic year. (Photos: Calvin Campbell left; below: James J. Snyder, '80)

tifying a niche and seeking to explore it fully. Such a quest will bring enjoyment," she wrote, "and may make you appreciate, if only in part, that which is M.I.T."

At the Killian Court picnic which opened orientation week, President Paul E. Gray, '54, had his usual counsel for freshmen: take advantage of the formal education which courses will provide; but be sure, too, to take advantage of the "informal education" that will surround you. And a special plea for serious commitment of energy and thought: "Preventing nuclear war is the most compelling goal of our times," he told the freshmen.

Dean Shirley M. McBay had similar advice about participating fully in the Institute community and added an assurance of support—good times or bad—from the Dean's office. She needed no introduction to the Class of 1986 on August 26. That had been taken care of earlier in the day by *The Tech*, which published her picture under a headline promising a "blast" at her policies on financial support for student activities from Charles P. Brown, '84, chairman of the Undergraduate Association's Finance Board. The Dean's office has failed to provide an adequate amount of money for student activities," said Mr. Brown, and he charged Dean McBay with "attempting to blackmail students to follow a course of action she wants them to take."

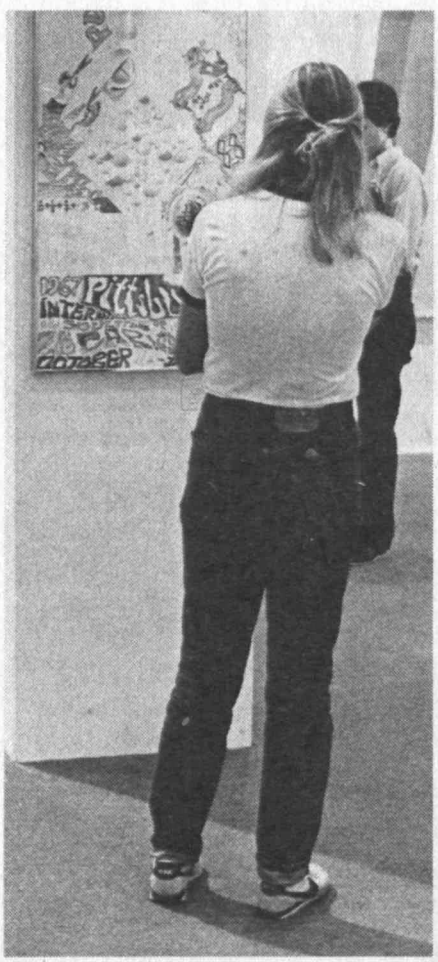
Rising Costs but Constant Demographics

Though confusion in Washington has made some funds late in coming, M.I.T. undergraduates have been able to count on federal student aid and loan funds for the current year much as in the recent past. Leonard V. Gallagher, '54, director of student financial aid, estimates that members of the new Class of 1986 are receiving some $530,000 under the National Direct Student Loan program—and they're benefitting from $2.8 million in scholarships and loans from M.I.T. In addition, they're being asked to earn more of their total expenses than their predecessors, meeting the first $4,000 of their need instead of $3,400 as last year.

Despite pressures from economic recession and rising costs—the average budget for 1982-83 will range from $12,900 to $14,100, excluding travel (tuition alone is $8,700)—M.I.T. freshmen come from the same economic background as their recent predecessors. Though other private institutions have reported declining portions of their students coming from the middle class, this trend is not visible at M.I.T., says Mr. Richardson.

Neil Welliver's Landscape *(right) is one of the prints that students could borrow for the year as part of the Student Loan Program.*

Modern Art: A Unique Plan to Help Students Understand It, Live With It, Even Buy It



"I don't know if it's a coincidence or not, but this year that I've spent with Large Egg by Kenneth Walker has been the best of my short happy life. Not only did the picture attract attention by itself, but it inspired me to start collecting pictures of ducks, turkeys, and other egg-related things. My dormitory room was most unusual with these additions, and always led to interesting discussions.

"For three years I've tried to get *Large Egg*, and I feel very fortunate that this time I got lucky. I can honestly say that I appreciate these art loans. It's just another subtle touch that keeps M.I.T. far ahead of all those other ordinary schools."

Once more this fall the Student Loan Program has given full-time students a chance to borrow a print for the year. Their choices were made at a September exhibition in Hayden Gallery of 209 framed prints and artist-designed posters from the Catherine N. Stratton Collection of Graphic Art and the List Student Loan Program—a broad range of contemporary prints including works by Albers, Dine, Francis, Gottlieb, Lichtenstein, Motherwell, Oldenburg, Stella, Warhol and Welliver, among other leading artists.

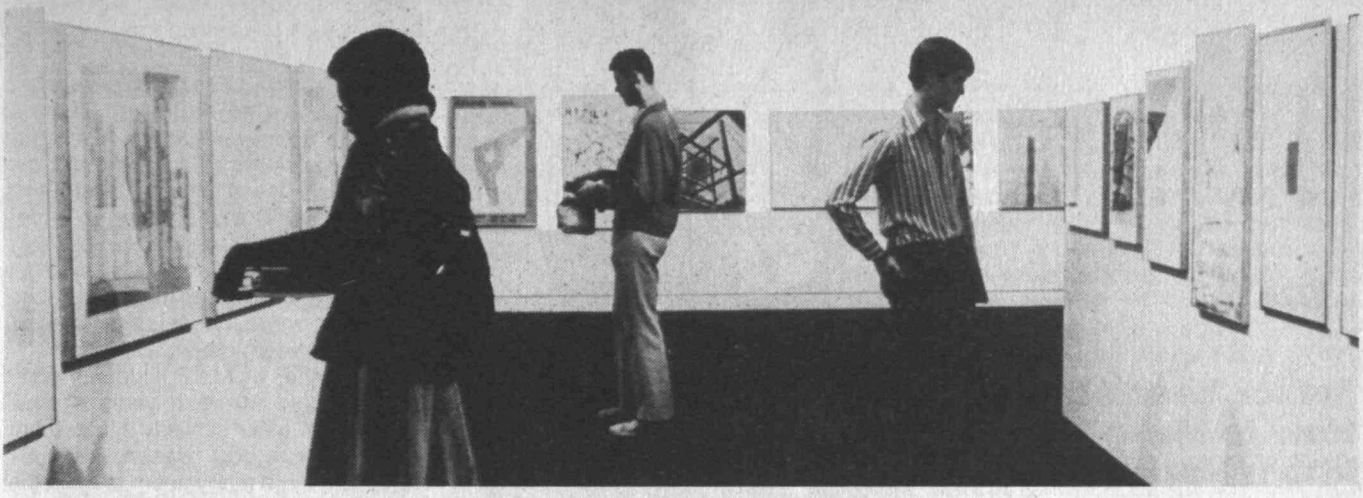
At least 1,200 students who wanted to live with one or more works of art during this academic year put in bids showing their first, second, and third choices, and with only 209 prints available a lottery was used by the Committee on the Visual Arts to choose the lucky winners.

". . . a Favorite Roommate is Missing"

The idea is to allow students to live with art in their rooms—and educational experience in art appreciation which may be as strong as could be accomplished in any classroom. It works. The program is increasingly recognized for its importance to student life. "It was wonderful to have a print in my home," said one student. "Since I took it down two days ago I have felt as if a favorite roommate were missing."

The original collection was established in 1966 by the Arts Committee (now the Council for the Arts) in tribute to Catherine N. Stratton, wife of M.I.T.'s 11th president and a staunch supporter of visual arts at the Institute.

Forty or 50 pieces were offered at that time. Then in 1977, Vera List donated about 100 framed prints which became the List Student Loan Program. Now John W. Taylor, '72, Director of the James A. Taylor Family Foundation, has established an endowment to support the program in which he participated as a student, and Alan M. May, '57, Director of the Dallas Community Chest Fund, has also created an endowment. "Since no Institute funds are allotted for the conser-



vation of the prints or acquisition of new prints, the two alumni gifts provide the base to maintain the program," explains Gary Garrels, Assistant Curator of the Committee on the Visual Arts. Friends and alumni of M.I.T. have also contributed their support.

The Process of Selection: How Is Judgement Taught?

How do students select the art they want to live with? To help understand the answer, the Committee on the Visual Arts began a pilot project this year to sharpen the critical standards by which students judge contemporary art. Their method: involve students in the process of art acquisition. For a "trial balloon," the committee asked students in dormitories and fraternities during last year's Independent Activities Period to explain how they would select works on paper for display in a public space in their residences.

Students were asked to explain the criteria they would use for selection, to discuss the kind of work and mediums they found interesting, to describe security provisions, and to discuss why and how the presence of an art work would affect their house environment. It wasn't quite like picking a work to live with for only a year; the work acquired by these students was to be sited permanently, and this "notion of 'forever' colored the way in which the students proceeded," explains a C.V.A. committee member. In the end the proposal submitted by the M.I.T. Student House was judged the most persuasive, and to its residents went the privilege of actually selecting a work for purchase.

The process of choosing a work to be on permanent view in their front parlor was not as easy as Student House residents had expected. First the students perused art in galleries and studios. They had to weigh many factors: available sites in their house, furnishings in those locations, figurative versus abstract works, how far their funds could be stretched, the competence of the artists considered, and—above all—"Can we live with it?"

Finally the students agreed on a large monotype by Michael Mazur. "While the Mazur print initially was considered too startling, it lingered in the committee's collective memory, suggesting that it would continue to provoke and reward scrutiny. Other works which at first had been more appealing proved less stimulating after a second or third viewing," explains a C.V.A. analysis of the project.

The C.V.A. staff says they enjoyed listening to the students' reaction to art works and trying to answer their questions, which turned out to be identical to those the committee wrestles with when choosing art works for the M.I.T. Permanent Collection. So a sense of shared mission prevailed.

"No Substitute for Looking . . ."

The opportunity proved extraordinary. Irene Baker, '82, describes the evolution of her perceptions and those of the six other members of the Art Committee from M.I.T. Student House:

"All of us on the committee had some previous interest in painting or photography, but we had little or no formal training, particularly in knowing or understanding contemporary art. We did try to prepare ourselves to be open minded and receptive to the work we were going to see."

This started with a look at slides of works by Boston-area artists presented to the committee by Susan Sidlauskas, a C.V.A. curator. Ms. Baker continues:

"On our first visit to a gallery we realized that appreciating art in a musuem, a book, or in someone's house was a lot different than trying to judge critically unknown, unsanctioned art. Each of us had to develop ways to look at the artwork. . . . We learned that each artist has to be looked at individually because there were no easily applied, absolute standards. We had to spend a lot of time and concentration when looking at a series of works by one artist. When we went on to another artist we had to start at the beginning, as we hadn't learned anything that we would substitute for looking long and thoughtfully. As we continued going to galleries we learned to rely on our instincts instead of trying to compare what we were looking at with previous works we had seen. Gradually the committee started to agree more often on what everyone liked."

The choice, when finally made, had to be defended. "Most of the House liked it but said that we spent too much money on it. . . . A small group of people disliked aspects of the print itself. They expressed doubts about the artist's intentions because of the 'imperfections' left in the monotype. They argued that the artist was trying to dupe the public into buying sloppy and quick work so that he could make money easily. In spite of attempts to explain the physical and aesthetic process of making a monotype, these people have remained unconvinced of its worth.

"We realized that we had learned a great deal," writes Ms. Baker. "Our perceptions were clearer and sharper, and we had confidence in ourselves when we liked something. We also found that our memories of the works were always a little different from their actual impression. As we have discovered with our monotype, even a picture that is seen every day can surprise the viewer with something that was not seen before. The conflict between the mental image of the work and the actual piece changed our experience of viewing art. What we once perceived as a static, two-dimensional representation of forms, lines, and colors became a subtle and dynamic experience."

The experience that Ms. Baker describes could be shared by many more M.I.T. students with a modest endowment for student acquisitions—$20,000 to yield perhaps $2,000 a year. A unique opportunity, says Kathy Halbreich, director of exhibitions for C.V.A.—*M.L.*

Junior Year Abroad: How to Make Yourself Into a National Asset

M.I.T. has always been proud of its role in educating foreign students. But that should be a two-way street, says Louis Menand, special assistant to the provost: "The faculty feels that M.I.T. students should have some chance to study abroad, too." Dr. Menand (he is also a lecturer in political science) is speaking to a group of students who have assembled to find out more about study abroad. Some have been; others want to go.

The number of M.I.T. students going abroad (about 30 each year) is small compared to other similarly situated universities. No good reason, says Dr. Menand, though many seem to think that the special character of the education here doesn't lend itself to overseas study. That's a fallacy, Dr. Menand told the group.

Students should recognize, as the faculty does, that there are many ways to grow, and one valuable way is to get out of the confines of this culture and this geography. "The old traditional view of education is that we all grow linearly," says Dr. Menand, "and this is not true—we zig zag all over the place. Lurching through life, I call it." Dr. Menand's advice is to exploit this process, not to be afraid of it. Just "keep an eye on what you're doing each step of the way," he told the students. "M.I.T. is not in the business of

In Respect for Time: On Student Life in Oxford

by Steven Solnick, '81

At M.I.T., I suppose, one gradually becomes used to waiting in lines. We endured lines at the Freshman Picnic, every Registration Day, at the Coop, at LSC, and, perhaps the longest line of all, at Commencement. "Endured" is really the right word, I suppose: we didn't relish our "hurry up and wait" existence, but I remember few if any street brawls on Amherst Alley prompted by someone bypassing a line. Lines just didn't seem that important, although I do remember registering surprise when I discovered that Washingtonians attended busses in neat single files, in such stark contrast to a typical Dudley bus mob.

Imagine my surprise to discover that one of the most striking differences in lifestyles overseas concerns the attitude toward waiting.

In Great Britain, "queuing" has been called the national sport and, unfairly, the only one at which the Brits excell (they're very good at darts). A few weeks ago, a friend and I went to a cinema in Oxford. In the lobby, obscurely placed, sat a sign which read "Queue here for the next show." Behind this sign stood, patiently, about a dozen moviegoers. My friend and I fell in behind them.

After a few minutes of toe-tapping, I went into the box-office to ask when sales would begin. "Why, they haven't stopped!" I was pleasantly informed. I waved my friend out of the lobby; he left the queue behind and we went into the show.

A bit later, as I waited (in line) for my Cadbury Fruit and Nut bar, the people in the lobby—about 15 at this point—began to realize that the sign they were obeying had been placed to get it out of the way. An instant of confusion ensued, then the queue shifted—carefully preserving the order—and presented itself at the box office.

Almost exactly the opposite situation rules in Morocco, an African country I was able to visit around New Years. In Morocco, lines and queues are about as much in evidence as indoor plumbing. My travelling partner and I first began to suspect this when we noticed aggressive mobs hovering outside movie theaters (a "Please Queue Here" sign would have been good for a few laughs). It was not thoroughly brought home to us, though, until we tried to telephone the U.S. one evening.

In Morocco telephones are rare and most calls are made from the local phone bureau. Well, on Christmas Day (as on all

ILLUSTRATIONS: JON McINTOSH

pushing students out of town for a year. We have crowded dorms but we do not deal with it in that way. We encourage students to look at how they want to grow."

Some cautions for those starting to investigate the process of overseas study: be sure what you can take and how you can have the credits accepted here. A question, for example: can you write a

continued in the next column

senior thesis while overseas? The answer is "yes," quite possibly—and it has been done. But don't assume anything; make sure.

Perusing London Bookshops and a Loose Tongue

Some students who just came back from study abroad shared their experiences:

"At the London School of Economics, I spent 80 percent of my time reading. I read on the subway, in the bathtub. I spent weekends trying to find obscure books we were assigned; there were no reprints, and some books were 100 years old. But I loved perusing the hundreds of bookshops in London. For one course at least 20 books would be suggested, whereas at M.I.T. it might be one or two," David Lingelbach, '83, told the group.

Lisa Granick, '83, went to Norway, where she studied Norwegian intensively in the first three weeks and then was immersed in courses completely in Norwegian. "As soon as I got there I refused to speak or read in English. I decided to *think* in Norwegian immediately—which was hard when I only knew 100 words."

A word of advice on learning language from another student: "Throw yourself in unprepared—*don't* learn the language first. Go to a pub, if you want to learn. Your tongue will be loosened; and people go there to talk. Take a flask of wine (the standard price is $5.00 for a beer) and fake it—talk like you speak it. I would stop someone and say with a heavy accent 'Excuse me, I'm Polish, do you speak English?' If they think you speak English worse then they do, they'll talk more readily. Another tip—carry around an erasable board with you, and draw pictures to ask what things mean. They'll say 'Wow, this guy's flipped out' but you can get away with it, since you're an American. *Ask* them: 'I want to learn Danish, can we speak for a little bit and you correct me when I'm wrong?' Get a captive audience, like on subways."

The learning process abroad should have more than an academic focus. One participant advised students: "It's important to think about the world beyond you. And it's healthy for this country to have Americans that understand other countries and cultures. It's crucial to spend time away from the strict academic subject that is in a large part your motivation for going abroad. Those of you who have gone and bring back knowledge of other cultures are a national asset."—*M.L.*

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other days in Moslem Morocco) the desk of the phone bureau was totally obscured by a throng. No fewer than 30 people were mobbing one poor telecommunications employee who was gamely trying to keep up by barking at the mob in Arabic and shouting in French into the receivers he held in each hand. At the desk, shrouded women and toothless men shoved money and slips of paper at the poor worker, who maintained an imperturbable calm transcending the cacophony of Arabic.

We finally pushed and shoved our way to the front of the crowd—discovering that a good shove was an accepted tactic in transacting business. In England a good shove could land you in a joust.

At the front of the mob we shouted until we were heard, pushed until we escaped, sat until we were forgotten, and then pushed and shoved again until we were remembered. Our calls eventually got through.

We thought this was just a product of crowd psychology until we tried to have our railpasses validated in a deserted rail station. We were waiting at a ticket window, peacefully, while the attendant dug out the proper validating stamp. An old woman stomped up behind me, looked me in the eye, threw an elbow block worthy of the Rams, and thrust some money through the ticket window.

"So," a casual observer might intone, "British are simply more patient than Moroccans, and M.I.T. students have more important things to worry about than lines." Well, that's partly right and partly very wrong.

The British, in fact, aren't all that patient. The Moroccans, likewise, are anything but hurried. On the contrary, Moroccans have the *lowest* ulcer rate in the world.

What Moroccans and British have in common, though, is that they know how to relax. Doing nothing is an important element of both lifestyles. At Oxford, I drink more coffee and tea over casual conversation in one day than I'd drink in a week at M.I.T. The pub is a crucial center of life at Oxford (as in every British town), and in addition to the 50 or so in town each college has its own pub.

Moroccans, even more, have raised doing nothing to a fine art. Moroccans sit for days, literally days on end, at sidewalk cafes drinking coffee or green mint tea. Young and old pass the hours sipping, chatting, and hailing friends across the street. It is, beggars aside, eminently peaceful.

In Oxford as in Marrakech, waiting is, important because *time* is important. How people spend their time is a precious choice, and whether they choose to queue or to push at least it is a sort of choice. At M.I.T. we really were too busy to make that choice, and we actually treated time in a rather cavalier manner.

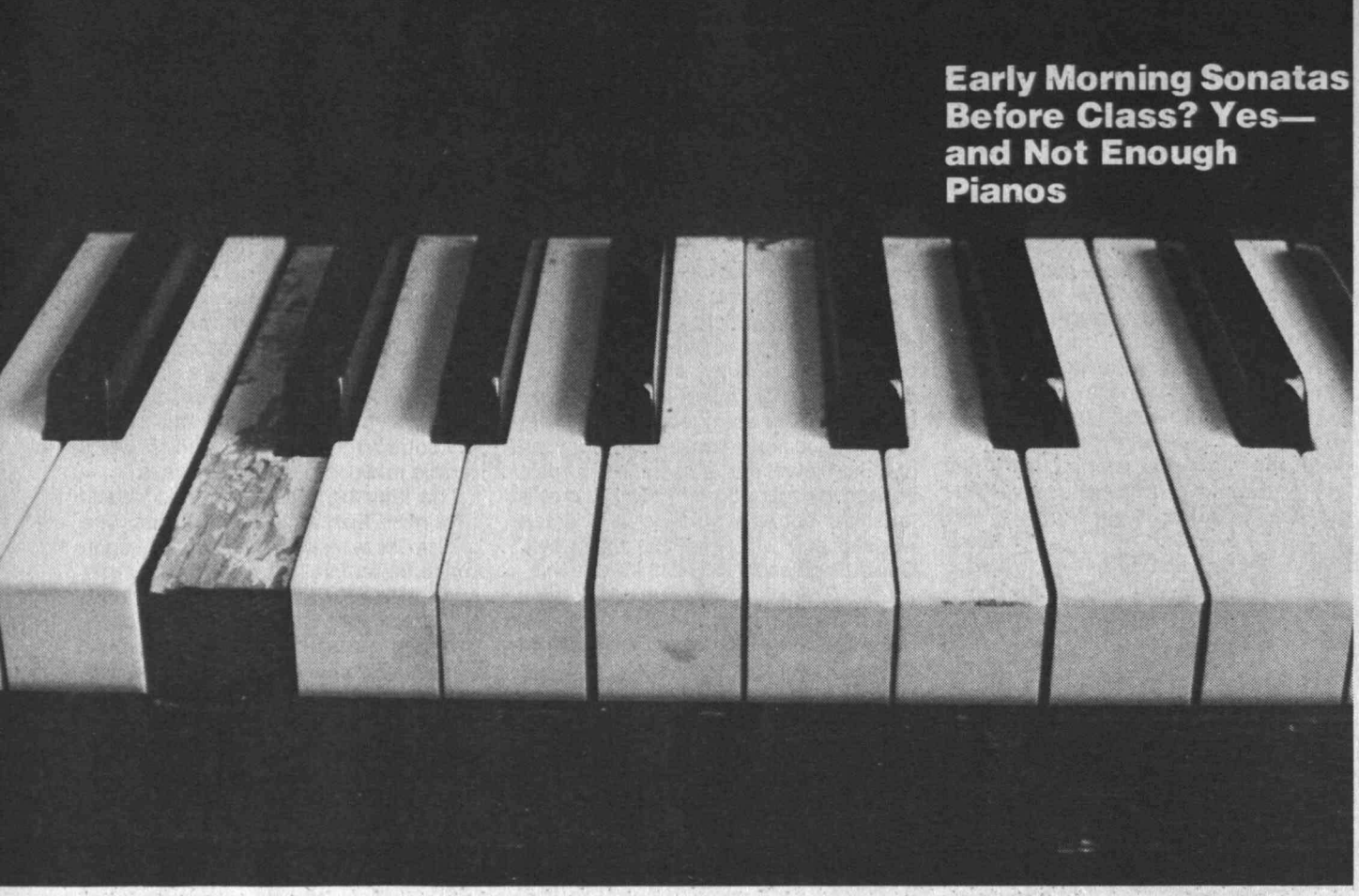
M.I.T. filled our schedules to the brim. When we partied, we often talked about how much work we should have been doing. We were—or at least I was—almost always busy, and doing nothing was often just an escape from doing something I was obligated to do.

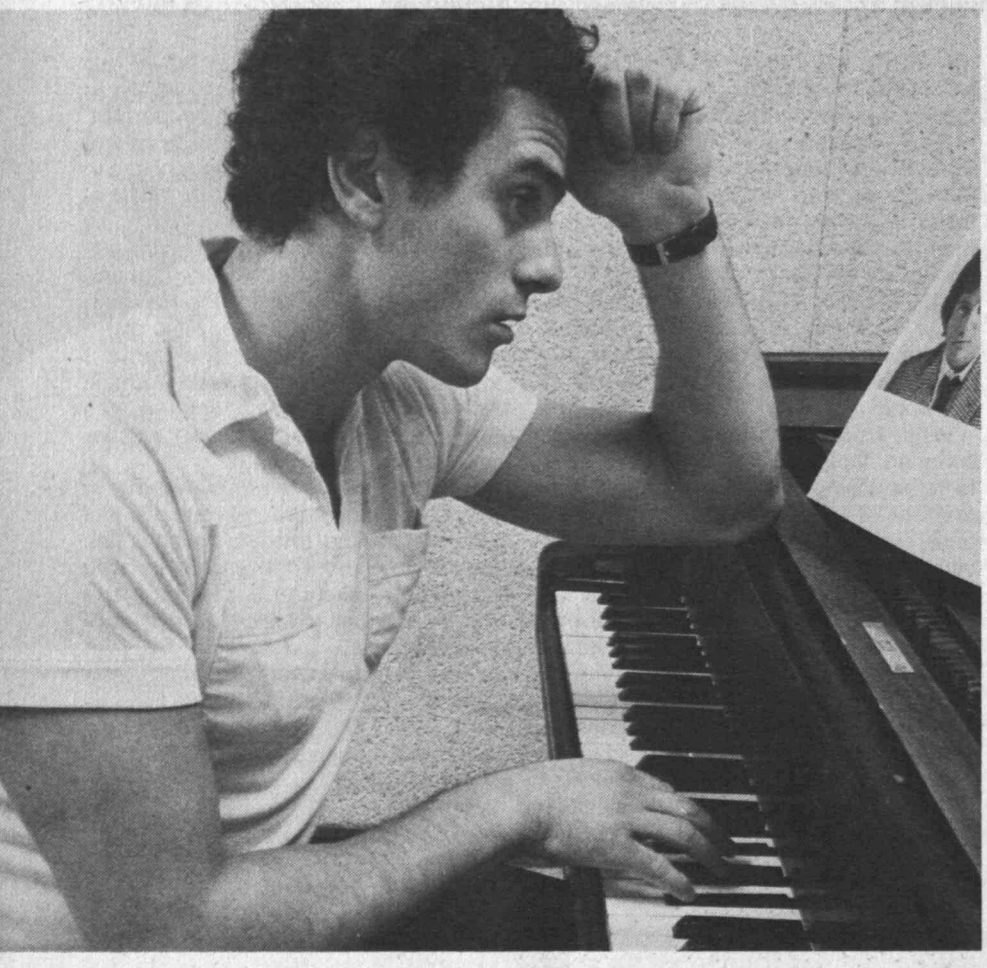
In Britain over coffee or over pints, in Morocco over mint tea, relaxation is just that: time for the mind to breathe and thoughts to form. That respect for time was notably absent at M.I.T. and it is a luxury built bountifully into the lifestyles of these countries.

It was, honestly, worth the wait.

Steven Solnick, '81, graduated with a degree in physics and won a Marshall Scholarship to study at Oxford.

Early Morning Sonatas Before Class? Yes—and Not Enough Pianos





It may be that in the wee hours of morning Bill is not laboring over problem sets, but sequestered in a small room on M.I.T.'s campus, creating music. "Most people think of M.I.T. as a place so concerned with academic performance that it leaves little time or incentive for piano playing," says Peter Smith, Associate Dean for Humanities and Social Sciences. "Yet there are many students who want to play even if that means at midnight after work in the lab or some early morning sonatas before class."

M.I.T. has never taken official inventory of all the pianos on campus. They inhabit back rooms and obscure corners as well as Kresge Auditorium and the "Piano Laboratories" of the Music Section. It can be said with certainty, however, that the forty-two-plus in practice rooms and dormitories are not enough to meet the enormous demand for their curricular and recreational use.

Student interest in music supercedes other priorities. At M.I.T.'s newest dormitory, 500 Memorial Drive, students voted last year to spend all of their $2,500 in discretionary funds on a piano before any other project. They even went so far as to commit themselves and the next four years of residents to repayment of over $5,000 from M.I.T.'s Office of Housing and Food Services to complete purchase of a Steinway. M.I.T. alumnus Dr. Robert Newman, '49, of the acousti-

Pianos are in enormous demand for curricular and recreational use. M.I.T. hopes to establish a sound basis for more systematic care of its pianos. (Photos: James J. Snyder, '80).

cal consulting firm Bolt, Beranek and Newman, Inc., personally advised students how to prepare their piano room acoustically. Mitchell Tasman, '83, the coordinator of this entire effort, also engaged the Housing Office in providing humidity control. These undergraduates made an unprecedented commitment to ongoing care of their new instrument, allocating $700 per annum for its tuning, regulation, and maintenance.

Such attention is sorely needed throughout the campus. According to M.I.T.'s piano technician Kathleen J. Allen, "There are 18,000 to 20,000 pounds of pressure downward on the strings of a grand piano, and 1,000 to 2,000 pounds of pressure downward on the soundboard. Combine that with deferred maintenance and intensive usage and we have an extreme problem. All this is exacerbated by New England's stark contrast of dry winter and humid summer—worse in Boston than anywhere else in the country."

Pianos administered by the Music Section for practice and teaching are tended regularly. But the turnover of students in the dormitories has not guaranteed attention to the slight problems that precede major breakdown. Consequently a high percentage of dorm pianos now need extensive rebuilding.

Over the years alumni and friends of the Institute have occasionally come forward with contributions to help address this problem. Among them, Otto A. Altenburg, '45, of Altenburg Piano House in New Jersey, Mrs. Harris Fahnestock, a member of the Council for the Arts at M.I.T., and the late Rudolph Gruber, '16, have supported the acquisition of grand pianos and underwritten practice space.

M.I.T. now hopes to establish a sound basis for more systematic care of its pianos: to this end it will seek funds to provide all Music Section and dormitory pianos with steady maintenance and if possible put them on a ten to twelve-year rebuilding cycle. "A grand piano, especially a Steinway, can be rebuilt and maintained to last indefinitely," says Ms. Allen.

Many M.I.T. students respond to the mechanical and scientific aspects of pianos. A "Physics of the Piano" offering during Independent Activities Period was oversubscribed: 60 undergraduates enrolled in this course intended for 12.

Primarily, however, their fascination is with the music itself. M.I.T. has long been known for the exceptional strength of its music program. H. Craig Russell, '83, a mathematics major and composer, notes a natural affinity between the mathematical orientation of many M.I.T. students and music. "Like music, mathematics has its own beauty in its structure. In some ways you have to be inside it to appreciate it. When you listen to music, you can't just listen, you have to feel. Similarly with mathematics, you can't appreciate it superficially, you need to let it occupy your mind."

The man at the Student Center library desk recommends Room C for a good piano, and a random passer-by agrees, as if everyone knew about the nuances of pianos at M.I.T.

Key in hand, you make your way down a shiny hallway to the large black door it fits. Unlocked, there looms another black door immediately behind the first, door knobs butting against each other.

Open the second door to see an old, chipped baby-grand piano. The top is propped open, its interior glowing gold, red, black and orange metal. The piano has been recently rebuilt. On the inside gold surface raised letters boast that it is a Steinway.

On the other side of the little room is part of an upright, its insides on the outside, the front missing, and half the keys and strings taken away.

Try playing the Steinway and the sound reverberates. As soon as you get involved, the absorption becomes total, the notes mesmermizing. It is a world unto itself, with you the creator. The chipped paint on the worn frame goes unnoticed, any original dismay replaced by solace, and delight in the experience of sound.

Sports Report
Ken Cerino

Emphasis on Participation

Ken Cerino is starting his fourth year as director of sports information; he is currently president of the Eastern College Athletic Conference Sports Information Directors' Association (ECAD-SIDA).

M.I.T.'s 32 varsity sports teams (21 for men, 11 for women) form one of the largest intercollegiate athletic programs in the nation today. Men's teams include baseball, basketball, crew (heavyweight and lightweight), cross country, fencing, golf, gymnastics, indoor and outdoor track, lacrosse, pistol, rifle, sailing, skiing, soccer, squash, swimming, tennis, water polo, and wrestling.

There are women's teams in basketball, crew, cross country, fencing, field hockey, gymnastics, sailing, softball, swimming, tennis, and volleyball. Competition includes New England colleges and Ivy League schools.

Joe Dinneen of *The Boston Globe* wrote two years ago that "M.I.T. will never participate in a football bowl game, but it has a college athletic program worthy to be the model and envy of many who will."

The emphasis at M.I.T. is on participation and the department is fortunate to have strong, effective administrative leadership to maintain this philosophy established several decades ago.

In athletic director Royce N. Flippin's 1981-82 report to the president, he noted that:

☐ Men's intercollegiate athletics had a participation increase (645 vs. 623) for the third consecutive year despite declining enrollment;

☐ Both the men's and women's intercollegiate programs have approximately 18 percent participation from their respective undergraduate student bodies;

☐ More than 800 men and women (including duplications) participated in approximately 600 events in and around the Boston area.

"One of our priorities is to insure continued broad-based participation and a wide variety of innovative and responsive programs of increasing excellence despite budget retrenchment," said Flippin.

The numbers are impressive, but the main ingredients for success are the remarkable student-athletes who represent M.I.T. in competition throughout New England and the nation.

Jeff Lukas, '82, is a perfect example. He's now attending medical school at the Hartford campus of the University of Connecticut, a short distance from his home in nearby Glastonbury.

Last May, Jeff received the Cochrane Award, an honor which goes to the senior showing the highest qualities of humility, leadership, and scholarship in intercollegiate athletics.

Jeff received 12 varsity letters in cross country, and indoor and outdoor track. As a sophomore, he won the 1,000-yard run at the New England Division 3 indoor championships. He was a member of four M.I.T. teams which won New England conference championships, and served as co-captain of the 1982 indoor squad which posted a 10-0 record, the team's best mark in 85 years.

"Jeff will best be remembered for his competitiveness and enthusiasm," said M.I.T. track coach Gordon Kelly. "His teammates respected his leadership abilities, electing him co-captain all three seasons his senior year."

Jeff also served as president of the Varsity Club and at the dedication of the Athletics center last December, he noted, "I'm very thankful that during my career I have seen that M.I.T. has a sincere concern for the quality of its sports program. When I think about my college experience, I'll never forget my association with sports and all the friends I met during my four years."

Many alumni echo Jeff's thoughts, saying that sports and recreational activities provide a tremendous outlet from the often gruelling schedule of problem sets and lab work.

That's music to our ears, but our objective remains to provide our student-athletes with a wide range of activities they can enjoy after graduation.

Club Sports Reach All-Time High in Participation

"Our policy is to provide an athletic program for the individual student which serves our educational objectives and provides wholesome recreation. In so doing, we encourage a maximum of student participation in athletics and give vigorous support to the interests of students who engage in intramural or intercollegiate competition."–Athletic Director Richard L. Balch, Technology Review, *November 1959*

The intramural program at M.I.T. continues to draw the largest number of student participants as more than 60 percent of the total undergraduate enrollment was involved in at least one activity in 1981-82.

There were 1,151 teams in 27 sports with an estimated 10,857 athletes, including duplications reflected by those students who competed in one or more sports.

Intramural sports along with the number of teams and participants follow: backgammon (43, 194), badminton (52, 124), basketball (138, 1104), bowling (108, 124), chess (12, 72), cross country (4, 35), cycling (9, 40), fencing (9, 41), football (80, 1200), frisbee (53, 530), hockey (78, 936), octathon (16, 192), pentathlon (6, 90), pool (30, 150), rugby (8, 72), sailing (12, 48), soccer (84, 1428), softball (160, 2240), squash (32, 160), swimming (8, 81), tennis (9, 140), indoor track (110 participants), outdoor track (38 participants), volleyball (144, 1152), water polo (42, 420), weightlifting (3, 24), and wrestling (11, 112).

Club sports continue to grow in popularity for those persons (especially graduate students) unable to make regular commitments to more highly-organized intercollegiate competition. In 1981-82, club sports reached an all-time high in the number of programs and participants. Women's soccer became the 30th recognized club this past fall.

Club rosters for 1981-82 follow: aikido (15), archery (11), badminton (20), bowling (11), cheerleading (12), cricket (24), fencing (25), figure skating (55), football (45), folk dance (40), frisbee (60), men's ice hockey (25), women's ice hockey (26), ice dance (30), Shotokan karate (30), women's lacrosse (12), pistol and rifle (45), men's rugby (47), women's rugby (17), scuba diving (25), Society for Creative Anachronism (20), grad men's soccer (24), table tennis (14), tae kwon-do (24), men's volleyball (20), women's water polo (13), white water kayaking and canoeing (20), wu-tang Boston (15), wu-tang M.I.T. (15).

There was a slight decline in total physical education registrations for undergraduate, graduate, and staff (6098 vs.

6134 the previous year), but an increase versus two years ago (6098 vs. 5861), and the third consecutive year of undergraduate registration increases (5190 vs. 5156).—*Ken Cerino, Sports Publicity Director*

Athletic Recruiting? "We Have To Wait for Them to Contact Us"

There are lots of good athletes in the new Class of 1986 (*see left*). But that's not because they've received some special inducements to come to the Institute.

The tradition of special deals for special players is absent here. "For one thing, there's no budget for it," explained Peter H. Richardson, '48, director of admissions, to Robert E. Malchman '85, of *The Tech*. But the real answer is that *every* student is admitted on the basis of ability to do M.I.T.'s academic work for a degree.

Within that limitation, good athletes are sought just as good musicians, good chess players, and good student leaders of all kinds—to assure a community that is at once extraordinarily diverse and extraordinarily competent.

When it comes to athletics, "our biggest task is to let people know that M.I.T. has a good athletic program . . . People just don't know about this part of M.I.T.," Mr. Richardson told Mr. Malchman.

When a prospective student indicates his interest in one or more sports, the Admissions Office shares that information with the Athletic Department, and the Athletic Department provides an evaluation: is this talent strong enough to become a factor in the community's depth and breadth? Francis C. O.'Brien, Jr., associate professor of athletics who's head coach of basketball and baseball, insists that this is the department's only input to the admissions process. "We want people who will be leaders, outstanding among all the students already here," he says.

Only after the admissions and financial aid decisions have been made do the communications assume a more aggressive posture. Mr. Malchman picks up the story with some examples:

When Gregory Abowd, a basketball and track star from Farmington Hills, Mich., was offered a place in the class of 1986 Coach O'Brien wrote a letter to introduce him to the school. He said that the concentration is on academics, Mr. Abowd recalls, but he emphasized how strong sports are, too.

Eric Fleming, '83, is the manager of the men's basketball team. His home is near Abowd's, and he visited the prospective engineer.

"It was very informal," said Fleming. "Greg asked questions about basketball and classes. He wondered how we had time to make a commitment to both sports and academics. I told him it could be done; that many people did it."

"We try to give the personal touches," said John Benedick, coach of the swimming and water polo teams. "We telephone and write like crazy once they are admitted. We try to give them a place to stay with a team member, arrange interviews if they're interested in a particular department. Even if they don't attend, we want them to come away saying good things about the program."

Mike Dichristina, '85, plays baseball and basketball. "When I visited last year, I talked with Mr. O'Brien," he said. "He told me that sports here strive for respectibility, but that you come to the Institute for academics.

"Several of the ballplayers live at SAE and they put me up. They were very helpful."

John Tantillo, '85, concurred. "I spoke to Steve Lubiak ['83], and he told me it was possible to play sports here. If I hadn't spoken to him, I might have had second thoughts about playing baseball." Both said their primary reason for coming to M.I.T. was the academics.

That's as it should be—*has* to be, says Mr. Richardson. He likes the relations between admissions and athletics just as they are at M.I.T.—a relationship with "both sufficient closeness and distance," he told Mr. Malchman.

Fencing: Now the Best Record of all M.I.T. Sports

The Friends of M.I.T. Fencing is a new official group affiliated with the M.I.T. Alumni Association. The charter lists three major goals: to provide regular contact between the M.I.T. fencing programs and the alumni; to channel support from alumni to specific projects for the fencing team, and to sponsor a new and improved version of the M.I.T. fencing club.

M.I.T.'s fencing teams have earned a national reputation. And within M.I.T., fencing now has the best record of all sports.

M.I.T. has now won the "Iron Man," the oldest intercollegiate trophy in the United States, four times in the past eight years.

Captain for this year is Epeeist Ray Holden. Captain of the women's team: Ya-Pei Chang, '83. The schedule includes meets with Notre Dame, Navy, University of North Carolina, and Cornell.

"The women's team is the strongest it's ever been," says Eric Sollee, coach.

He invites "the rusty blades to come into the fencing room to try out their skill against a new generation of fencers." Fencers can be found at practice Monday through Friday between 4:00 and 7:00 p.m.

Classes

John Staub, '15

08

The following note comes to us from Mrs. Emerson: "**Alexander M. Emerson**, now in his 98th year is living in a nursing home. He is in fairly good health and gets around with the help of a cane. He would enjoy hearing from alumni." Mail will reach him in care of his wife at P.O. Box 72, Acton, MA 01720.—**Harold Osborne**, Secretary, Penacook Rd., Contoocook, NH 03229

15

Thinking that every '15er would be interested to know who attended Technology Day this past June and realizing that **Wally Pike** always attended, I telephoned him. He reported that he had had a bout with congestive heart failure and was in the hospital in June, so it was his first time to miss. However, he advised me that he was up and around, feeling better, and he sounded just like his old self. Mentioned that he frequently talks to Barbara (Mrs. **Howard Thomas**) and that she always likes to be remembered to the classmates.

Wally said he bet **Evers Burtner** attended the alumni festivities, so I gave him a call. Sure enough, he did, and reported that out of the "class supreme" he was "the only boob there!" He also told me that he had a nice letter from **Ellis Ellicott**, which pleased him immensely, and that he would send along some information to be used in a future issue, so be prepared!

Which reminds me, fellas, please drop me a line with any news whatsoever, so we can keep up-to-date on each other.

Naomi Kubitsky, daughter of the late Dr. **Joseph Finck**, writes from Doar Kfar Vitkin, Israel. I have continuously kept in touch with her mother, Joe's widow, wherein Naomi told me if I was ever in her part of the world she would have a room for me, probably facing the Mediterranean. Naomi's family still have her parents' house in a village on the sea. Doesn't that sound fantastic?

Would like to mention that there are 44 active alumni in the Alumni Office's final statistics report for the Class of 1915. We had 59 percent participation in this year's fund. I am so proud of you, and now we are into the 1983 fund drive, so keep up the good work!

It is the time of year to wish each '15er a wonderful holiday season. Happy Thanksgiving—eat lots of turkey, and have a very merry Christmas and a happy New Year!—**Joyce E. Brado**, "Your old Class Agent," 491 Davison Rd., Apt. 9, Lockport, NY 14094

16

Paul Duff's son, Dr. John Duff, sent us copies of the pictures of our reunion luncheon in June. They really captured the flavor of that wonderful gathering. We are indebted to Dr. John Duff and Dr. Paul Duff for providing us with a group photo for each participant along with the candid shots. . . . Had a nice letter from **Dan Comiskey** indicating that he and Grace

A Tribute to John F. Staub, '15

*Gerstle Mack, '16, sent the following about his "old friend and former classmate," **John Fanz Staub,** "a distinguished and phenomenally successful architect":*

John was born in Knoxville, Tenn. on September 12, 1892, the son of Fritz and Anna Staub. His paternal grandfather had emigrated from Switzerland. While at M.I.T. John was known to all his friends as "Fritz," but World War I made German-sounding names unpopular, so he abandoned the Teutonic nickname in favor of his real name, John.

There were only ten of us in our 1915-16 post-graduate class. Our work was supervised by the late Edgar I. Williams, a Rome prize winner, except for one problem in Gothic architecture which was directed by Ralph Adams Cram. At that time the school was housed in several old and more or less decrepit buildings near Copley Square in Boston. The move to the new campus in Cambridge coincided with the end of our post-graduate year in June 1916. Soon after he left M.I.T. John Staub went to work for $12 a week in the New York office of Harrie T. Lindeberg, who specialized in country houses. When the U.S. entered World War I in April 1917, John enlisted in the Naval Reserve Flying Corps. He was stationed in England and piloted one of that period's fragile, primitive planes said to have been "made of tissue paper and spit—mostly spit." For a successful operation against a German submarine, John was awarded the Navy Cross.

In January 1919 he returned to Lindeberg's office, and in October of the same year he married Madeleine Louise Delabarre of Conway, Mass. In 1921 he accompanied Lindeberg to Houston, where the older man had been commissioned to design three or four important residences. John realized that Houston, rich with oil money, was destined to grow in affluence as well as population, and decided to settle there and open his own office. During the next forty years his firm built about 130 houses for wealthy citizens of Houston and other Texan cities, as well as a few for clients outside of the state.

John and Madeleine were extremely popular socially, and many of his clients became close friends. John took great pains to understand the individual tastes and life styles of the families for whom he designed houses, an important element in his success. In 1936 he took Thomas Rather, Jr. as a partner, and in 1952 he acquired another partner, Albert Howze, and the firm was reorganized as Staub, Rather, and Howze. He retired from active practice in 1963. Rather died in 1968, and the firm was finally dissolved in 1971.

John Staub's style was eclectic. His houses were never copies of older buildings, but they exhibited a wide variety of influences: Tudor, Georgian, French, Italian, Spanish and Spanish-American, and Louisiana Creole. He did not feel at home with Bauhaus or other "modern" systems, and his attempts to design in what was to him an uncongenial idiom were relatively unsuccessful. He brought impeccable taste and refinement to all of his work. In 1979 Howard Barnstone and three assistants composed a large handsome book entitled, *The Architecture of John F. Staub; Houston and the South*, published by the University of Texas Press. It is profusely illustrated, the photographs including 28 in color, and contains floor plans and illuminating descriptions.

John enjoyed unusually good health all his life until early in 1981, when he suffered a series of minor strokes and finally a massive and fatal one. He died on April 13, 1981 at the age of 88. His wife, who had been a semi-invalid for several years, died on October 25 while sitting quietly in her wheel chair. John and Madeleine Staub are survived by one son, John D., now a surgeon in Houston; and two daughters: Nancy (Mrs. William A. Wareing, Jr.) who lives in Fredericksburg, Tex., and Caroline (Mrs. Charles Callery) of Houston; ten grandchildren and four great-grandchildren.

were having a good summer with both of them feeling much better.

Dina Coleman writes this interesting letter: "Well, I am back from Iceland and have answered most of the questions as to why I wanted to go there. The fundamental answer has always been, 'Because it is there.' The entire island, of course, is volcanic and sits astride the Atlantic rift between America and Europe. On a five-day guided tour we saw modern architecture, ancient architecture, waterfalls, glaciers, geysers, and hot water springs. The entire island is heated from the hot water springs which also supply heat for the large greenhouses in which all manner of vegetables are grown. One day I complained to the guide about not being shown the rift, and she replied that we had walked down the rift but I was too occupied with one of the blondes to notice it. Prices are high, of course, but (except for cocktails) not any higher than New York. I would recommend the trip."

This note from **Joel Connolly**: "I have just now looked at the photos in the 1917 *Technique*. It is interesting to see how we looked 66 years ago! How many members of M.I.T. '16 are still known to be living? Virginia remains the same, I take flowers from our yard to her daily. Last December 2 I had a mild stroke and am slowly recovering. My doctor will not let me drive a car, but good friends take me places in their cars. The stroke has affected my balance somewhat (both physical and financial). However I do not complain. Things could be a lot worse."

We regret to report the death of our classmate, **Herbert A. Pieper**, who died on July 19, 1982. . . . Keep eating, drinking, walking, breathing, everything in moderation, and yes, of course, keep writing.—**Ralph A. Fletcher**, Acting Secretary, Groton Rd., West Chelmsford, MA 01863

17

Phil Cristal, following a long illness, died on June 26 in his home in Manchester, N.H. He had lived in Manchester since moving there from Milwaukee, Wis., 23 years ago. He wife, Romola, survives him. Those of us who know Rom, from various reunions, send her our sympathy . . . **Thomas P. Pitre**, who for more than 30 years was M.I.T.'s chief administrator of financial aid programs, and who in 1948 was made an honorary member of the Class of 1917, died on February 27 after being stricken suddenly at his home in Dunedin, Fla.

After accepting my new assignment as class secretary, I was delighted to learn how effective the Alumni Office in Cambridge is in keeping me posted on bits of class information. And it would be very helpful to have those bits supplemented by information coming directly to me from members of the class.—**Walter J. Beadle**, Secretary, Kendal at Longwood, Box 217, Kennett Square, PA 19348

18 65th Reunion

We were very happy to receive a warm note from Mrs. Hugh Bagby whom we knew on so many happy occasions as Frances (Mrs. **Edwin**) **Harrall**. She is busy with her garden in suburban Baltimore. It was good to know that '18 friendships endure.

Elizabeth (Mrs. **Julian C.**) **Howe** has moved to the Adams House, 1168 Highland Avenue in Fall River, Mass., where she will be near her daughter's house in South Dartmouth. We talked to her on the phone—she is adjusting well to her new home.

John Abrams sends a copy of a letter he wrote dated November 22, 1968—a bit of nostalgia: "In passing on to you a recent letter from our genial classmate **David 'Packey' McFarland** for timely excerpts on his vigorous retirement, I'd be remiss if I didn't indulge in a few observations anent your first column as secretary. Rare indeed are men of the quality of mind and heart as **Alexander Magoun** whom you now succeed. We all do a little introspection when such a grand guy goes to his reward and realize, at our time of life, how mean we are, by comparison. Here in the heart of the beautiful Eastern Sierra, semi-retirement finds me busier than ever, it seems. One job is, like yours a secretaryship but uniquely, of an ancient and honorable society, the Bishop Creek Water Association. Beginning a hundred years ago the settlers near this picturecard mountain stream diverted its water into scores of miles of ditches and 500 homeplaces. Today, after making our valley green, they converge into the vast watershed of the Owens River to flow by aqueduct to Los Angeles. One arm of the creek traverses our place and harbors, under our kitchen window, a big pet rainbow trout named Clayton. I belong to a tri-county technical action panel, a science society, and a historical society with livewire members from many federal and state agencies and the nearby Caltech radio telescope facility. For several months I've been working on a study of filtration by sand and leaf filters of domestic water. It took me back to my bachelor's thesis and the struggles with the Poinseville equation for capillary flow and an old Sweetland press. Again, looking back to the happy days with my old confrere **Sam Chamberlain**. I've been fascinated as I read the story of his eventful life in my autographed copy of his *Etched in Sunlight* and say, 'What a great gent!' " John adds a current note: "Hobbling around on a cane—you can't keep a good man down."

Thanks to **Len Levine**, and we note with sadness the passing of **John Clarkson**. He was 87. He retired in 1960 after working 40 years as a production planner at the Hood Rubber Co. in Watertown. During World War I he served as a lieutenant in the U.S. Army Air Services. He leaves a brother, Albert B. of Portsmouth, N.H.; a sister, Dorothy Lloyd of Exeter, N.H.; two sons, John W. Jr. of Westerly, R.I., and Frank E. Clarkson of Shrewsbury; three grandchildren and two greatgrandchildren.—**Max Seltzer**, Secretary, 1443 Beacon St., Brookline, MA 02146; **Leonard Levine**, Assistant Secretary, 599 Washington St., Brookline, MA 02146

19

You will be glad to know that we received 43 replies to our poll of the class of 1919 for the 65th Reunion in 1984 and that the prospects for the normal attendance at this late reunion look at this time as favorable as other classes at the same stage. We can do it too. As promised here are some more quotes from those who responded to the poll. **George R. Bond** still enjoys "quite good health and keeps very busy every day" . . . Some humor from **Oscar A. De Lima**—"Chinese movie fan calling on the phone: 'How old Cary Grant?' Chinese answering service: 'Old Cary Grant fine. How you?' . . . And from **Benjamin H. Bristol**: "Active." . . . **Allan H. McIntosh** writes, "Good health. Hope I can be in Cambridge in '84." . . . From **Timothy E. Shea**: "Generally good. I have been in New Mexico, Texas, Florida, New York state, and Massachusetts, visiting family. Travel by phone these days. Have no idea where I will be in June '84."

With regret we report the decease of four more classmates. **Donald Kitchin**, at 86, passed away on May 7, 1982 after a long illness. Donald was a research scientist with Arthur D. Little and others including the Research Lab for Applied Chemistry at M.I.T. . . . **Max Knohel** died on May 7, 1982, also after a long illness. Max was a consulting physicist and the developer of the familiar ball point pen. . . . **Webster B. Shippey** died August 29, 1981. At this writing we have no record of his career. John's wife responded for him to the class poll and advised us of his death.

Happy Holidays to you and yours.—**Will Langille**, Secretary, Box 144, Gladstone, NJ 07934

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It is with regret that we announce the loss of our classmate **John S. Visscher** on April 19. John had long retired, then moved to North Andover. Previous to that, he lived in Pawtucket. He is survived by a daughter.

News of the class has been hard to come by, of late. We can only hope that all of you have spent a healthful and enjoyable summer. Do write and tell us of your doings. We'd love to hear from you.—**Harold Bugbee**, Secretary, 21 Everell Rd., Winchester, MA 01890

21

We are saddened to report the death of **Wallace T. Adams** of Middletown, Ohio on July 5, 1982. A letter from his wife Anne told of his having hip surgery and making a good recovery until complications set in. Your secretary's friendship with Wally goes back to freshman days at M.I.T. He was one of the Lynn, Newburyport group that stopped in frequently at the dormitories. During his career, Wally worked 20 years as an engineer for the state highway department in Illinois. He joined Armco Steel in 1942 and retired in 1964 as senior sales engineer. He was active in Boy Scouts and received the Silver Beaver award in 1962. Wally attended many of our reunions including our 60th last year. A loyal alumnus, he was one of the M.I.T. Sustaining Fellows. Our deep sympathy goes out to his wife Anne. We shall miss him. . . . Professor **Juntaro Kawai** of Tokyo, Japan, died on July 21, 1963.

A clipping from the *Cheshire*, (Conn.) *Herald* tells of **Walter H. Kittredge** receiving a special award and a standing ovation at a Sunday service at the First Congregational Church. The award cited his many years of outstanding service and devotion to the church. Walter also has served as a consultant on the town planning commission. He retired from the Southern New England Telephone Co. in 1963. Congratulations. . . . A letter from **Cac Clark**, class president, reports that **Munroe Hawes** celebrated another birthday on July 4. How about writing me a letter, Munnie?

Cac arranged with the Alumni Association to have invitations sent out to classmates to attend the Alumni Officers' Conference this fall in San Francisco and Philadelphia. Personal postcards are being sent out to 30-40 classmates on both the West Coast and the New Jersey, Pennsylvania, Maryland, and Delaware areas. It is hoped some good interim 1921 reunions will be held at these conferences. Another regional M.I.T. meeting will be held at Disneyworld, Fla. in March 1983, and hopefully 1921 will have another interim reunion there. This is all the class news we have this month. Your secretaries would like some more input.—**Sumner Hayward**, Secretary, 224 Richards Rd., Ridgewood, NJ 07450; **Josiah D. Crosby**, Assistant Secretary, 3310 Sheffield Circle, Sarasota, FL 33579; **Samuel E. Lunden**, Assistant Secretary, 1149 S. Broadway, Suite B-800, Los Angeles, CA 90015

22

Ed Merrill is the author of a recently published book entitled, *For the Sake of the Trust: Sherlock Holmes and the Musgrave Ritual*. It was in 1963 that Ed discovered the singular world of Sherlock Holmes and became an active member of several Sherlockian societies. His *Holmes and Brunton: Civil Engineers* won him the Morley-Montgomery Award for the best article to appear in the *Baker Street Journal* in 1970, and in 1972 he was admitted into the Baker Street Irregulars. Ed and Vickie now live in Tulsa, Okla. at 1722 S. Carson Dr.

Last June, at a gathering at the M.I.T. Boat House, two shells purchased by the McCurdy Endowment for Crew were christened—one the *Paul E. Gray* and the other *The Ebee*, after Edna B. Smith, wife of Ross J. Smith, former director of athletics. A third shell given by **Mac McCurdy** was most appropriately christened *H.W. "Mac" McCundy*, with accompanying remarks by Mac's son, James G. ('48) and response by President Paul Gray. (See *Technology Review*, October 1982, p. B15.) . . . The July issue of *Hallendale Digest* (Florida) features a picture of **Ray Burrus** on the balcony of his home waving the American flag. The caption reads, "Now, in these later years, he enjoys feasting his eyes on its glory from his easy chair in the comfort of his living room. We salute him and the American flag."

Sandra Knight of the *Review* was kind enough to send me a print of the picture of our reunion group

taken at the Gardner Museum. I must say that if the 30 or so who were there are representative of the other survivors, there should be no trouble mustering a quorum for our 65th. . . . **Werner Schoop** of Zurich, Switzerland, could not come to the reunion because, due to an accident, he is partially paralyzed. Our best wishes, Werner, for your recovery.

Most of the members of the Class of 1922 probably reached the peaks of their careers some years ago, but there is one among us whose performance has been on an ever-ascending curve. **William B. Elmer**, whom we remember as art editor of *Voodoo*, was in July 1982 designated Most Extraordinary Person in the entire state of New Hampshire. The search for New Hampshire's most extraordinary person began with an editorial in the *Manchester Union Leader*. Bill's resume was one of 114 entries. The Manchester Chamber of Commerce, having carefully considered all entries, gave out a statement saying, "William B. Elmer of Thornton, N.H. is extraordinary in every sense of the word." There followed a summary of all the things Bill has accomplished with particular reference to his work on reflectors, which has brought him world renown; street lighting; decimalizing the American inch; a new pendulum invention that will be an improvement over the famous Foucault pendulum, and his 1944 torpedo mine which was credited with sinking four ships during World War II. Further, Bill, a competent concert pianist at age 81, is the composer of 29 classical piano pieces as well as two church hymns. He is also an artist, having drawn an extensive series of charcoal portraits, including some musicians of the Boston Symphony Orchestra which will appear in the history of the BSO now in preparation. Along the way came more than 50 patents.

In 1966 Bill, at his own expense, won a decision in the New Hampshire Supreme Court to keep a privately owned beach at Mirror Lake (North Woodstock, N.H.) open to the public. This was deemed "a genuine public service to New Hampshire." Finally it should be noted that New Hampshire's Most Extraordinary Person designed a reflector for the "walking stick camera" used by astronaut Armstrong. The reflector and camera remain on the moon. Bill and his wife Cathleen Burns Elmer (writer) have a son Edward Burns Elmer, age 24, who is in his fourth year at Harvard Medical School. To keep himself busy, Bill is the proprietor of the 100-acre Greenspires Tree Farm. Bill, our compliments to you.

Class president, **Parke Appel**, on returning home to Florida after our reunion, immediately got busy on planning the 1982-83 program for the M.I.T. Club of Southwest Florida. Another justification for the Bronze Beaver Award.

Correction: the notice in the April 1982 class column of the death of **Charles S. Comey** was wrong. Chuck is still very much alive. It was his wife Christine who died in May 1981.

Deaths of classmates: **Warren Don Sherman**, July 24, 1982, Farmington, Conn.; **Cecilio Alinastre**, May 9, 1980, Bacolod City, Philippines; **James M. Waechter**, November 23, 1981, Hollywood, Fla.; **George L. Erickson**, April 6, 1979, West Palm Beach, Fla.—**C. Yardley Chittick**, Secretary, Box 390, Ossipee, NH 03864

23 60th Reunion

Royal Sterling, our 60th Reunion chairman, writes that preparations are under way. Royal and Mary attended Technology Day and found that as of that date a dozen people had expressed their intention of attending the 60th, including Kay and **Jay Stratton** and **Conchita Pearson**.

After the 55th Reunion, our movies were turned over the M.I.T. Museum and Historical Collections and have been edited down to a single 40-minute film with sound track, which will be available for our 60th.

Pete Pennypacker will be entertainment chairman. In Cambridge we shall be housed in McCormick Hall. After the Technology Day luncheon, we shall go again to the Lighthouse Inn at West Dennis on the Cape, where we had such a wonderful 55th. If you have not received your reunion letter by the time you read this preliminary notice, it will be forthcoming soon. Mark the dates: June 8-9 on the campus, June 10-12 at the Cape.

The Ragnar D. Naess Music Fund was recently established by **Ragnar Naess**, in cooperation with the M.I.T. Council for the Arts, to be used at the discretion of the chairman of the music section to advance music at the Institute. Under the provisions of the fund, six student musicians have been selected for scholarships to provide private lessons for instrumental study.

Salvatore Guerrieri writes that he has been deeply concerned with the lack of rational energy policy especially as it applies to coal usage, and that he is trying to find a way to get people interested in his ideas. . . . **Raymond Meekins** writes that so far he finds the southern Appalachian highlands a most interesting place to live. . . . Bowdoin College honored **Philip S. Wilder** by dedication of the Wilder Room, a spacious conference room located in Hawthorne-Longfellow Hall, on May 28. Philip attended the Institute as a member of our class until 1921 when he transferred to Bowdoin from which he graduated with a B.S. degree in 1923 and later was awarded an Ed.M. degree from Harvard. He joined the Bowdoin administrative staff in 1927 as acting alumni secretary, and from 1928 to 1932 served as both alumni secretary and an instructor in education. He was appointed assistant to the president and foreign student advisor in 1946, named director of student aid in 1959, served in both capacities until 1967, and continued as foreign student advisor until 1971. He received the Alumni Service Award in 1968 and served as secretary of the president and trustees from 1971 until 1977, when he was elected as an overseer emeritus.—**Richard H. Frazier**, Secretary/Treasurer, 7 Summit Ave., Winchester, MA 01890

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The news has finally leaked out. **Phil Blanchard**, our class president, is the undercover agent in our negotiations. He hosted a luncheon April 27 at the M.I.T. Faculty Club attended by **Don Moore**, **Herb Stewart**, and **Russ Ambach**. The chief subject discussed was the class treasury situation. It seems that as of today no one has ever been able to determine from the Institute organization just what our status is. Don will try again. By the time of our 60th, Endicott House will have acquired 40 more rooms. Phil also discussed the Maclaurin Fund as a desiriable avenue for class gifts.

John Early Jackson passed away unexpectedly October 21, 1981 at the Lynchburg, Va. General Hospital. He gained his S.B. in electrical engineering in three years after attending Vanderbilt University. He immediately joined General Electric in Schenectady, then Lynchburg Traction and Light, Central Virginia Power, and became Lynchburg manager of Appalachian Power Co. from 1927 to 1946. He was granted leave of absence from 1942 to 1946 to join the Chairman's Office of Scientific Research and Development in Washington. He served as an army intelligence specialist, G-2, 1946-1954; executive secretary to the coordinating committee on atomic energy 1954-1958; and director of the office of Atomic, Biological, and Chemical Warfare, 1957-1962, when he was named director of Atomic Programs. He retired to Lynchburg with his late wife.

Reverend **Gertrude G. Harris** died June 19, 1982 in Rutland, Vt. She was on of the five young ladies appearing among 504 men's photos in the 1924 *Technique* and was a member of the Cleofan Club for four years. Gertrude attained her S.B. in chemistry and entered research in the food industry before becoming a research librarian for Standard Oil of New Jersey. She later changed to the religious field, leaving during World War II to become chief librarian (research) of the Lukens Steel Co. In 1945, attracted to the ministry with her M.A. from Columbia and Doctorates from two seminaries, she became a Methodist minister. After a stint with the Koinonia Foundation in Maryland, she retired to Wells, Vt. as a librarian.

Dr. **Edward A. Saibel** has a note on his Alumni Fund envelope: "I am presently chief, Solid Mechanics Branch, Engineering Science Division, U.S. Army Research Office, and adjunct professor at Duke University, North Carolina State University, and Wayne State University."

Herb Stewart, currently consulting for Charles T. Main, Inc., Boston, found that it pays to advertise. At the suggestion of John Mattill, *Review* editor-in-chief, Herb appeared in the May/June issue with David Libby, '85, only the second man to emigrate to M.I.T. from Herb's adopted Woodland (2,000), Maine. This exposure by two "Maineiacs" brought letters to Herb from John B. Drisko, '27, and John C. Melcher, '28, two old friends who had little contact for many years.—Co-secretaries: **Russell W. Ambach**, 216 St. Paul St., Brookline, MA 02146; **Herbert R. Stewart**, 8 Pilgrim Rd., Waban, MA 02168

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A letter from **Masaru (Kamy) Kametani** brings word that he is already looking forward to our 60th Reunion in 1985. He and Hisako hope to attend and see his many friends and classmates. Kamy's letter, which came air mail, said he'd sent me a Japanese calendar by sea mail and it should be arriving shortly. That he could be so accurate is hard to believe, but the calendar arrived the day after his letter reached me. It has a number of beautiful scenes from Japan.

It is with sorrow that I have to report the passing of **Theodore (Ted) Butler**. He died of a heart attack in the Memorial Hospital, Worcester, Mass. on June 15, 1982. His wife Linda wrote me, and further information appeared in the Worcester papers. The Butlers lived in Grafton, Mass. for the past 30 years.

Following graduation from M.I.T., Ted graduated from the Harvard Business School and attended Boston University. Ted, a former chairman of Grafton's school committee, was associated with various subsidiaries of the New England Electric Co., holding engineering and managerial posts for 39 years, until his retirement in 1967 as vice-president of the Massachusetts Electric Co. in Worcester. Ted was active in community affairs and was a member, senior deacon, and chairman of the board of trustees of the Evangelical Congregational Church of Grafton. During World War II he served in the Navy and was the commanding officer of the 15th and 101st Naval Construction Battalions during the battle of Okinawa. For his war efforts he was made an honorary Kentucky Colonel by the governor of that state. Ted leaves his wife, Etheline R. (Reed) Butler, and a son, Theodore H. Butler, Jr., a soil scientist in Exeter, Maine.—**F. Leroy (Doc) Foster**, Secretary, 434 Old Comers Rd., P.O. Box 331, North Chatam, MA 02650

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The Alumni office forwarded to us for inclusion in the class notes a press release announcing the election of **Orville Freeman** as chairman of the board of directors of the ASEAN Agro-Bio Co., a joint venture of International Plant Research Institute and a subsidiary of Sime Darby Berhad of Kuala Lumpur, Malaysia. The company applies genetic engineering and recombinant DNA technologies to agricultural crops in the Far East region. Freeman has served as secretary of agriculture under Presidents Kennedy and Johnson and as governor of Minnesota from 1955-1961. He is also active as chairman and director of numerous national and international institutions. The International Plant Research Institute develops and applies advanced genetic and other biotechnologies to photosynthetic plants for the profitable production of food, seed, and chemical products, employing over 110 scientists.

Recently we received a letter from Francis E. Low, provost of M.I.T., concerning developing plans for the Elizabeth and **James Killian** 1926 Professorship. The chair was held from 1972 to 1978 by Elting Morison and for the last few years by Visiting Professor Gerald Holton. Present consideration of a second permanent appointment inclines toward a distinguished scholar in the field of economics with the focus of the professorship shifting to the Department

of Economics. Jim gives the plan his full and enthusiastic endorsement. Dr. Low closes with, "It is a pleasure to bring you this good news, and to extend warmest thanks to you and your classmates. We are grateful today, as we have been for almost 16 years now, for the wonderfully generous gift of the Elizabeth and James Killian 1926 Professorship."

A most interesting letter from **Pink Salmon** tells of his almost frenetic activity as director and treasurer of the Pennswood Village Residents Association for the past two years, over which they built up from zero to over 53 committees. His mailbox and telephone were busy all the time, and now at long last he's really retired. An enclosed schedule of activities available to the residents confirms his comment: "There's so much going on here that we don't seem to get anything done. We still have four storage bins full of books, small furniture, other household goods, and all my tools, which we haven't had time to even start unpacking yet—but we'll get at it soon!(?)." To get away from it all they are planning a three-week tour of Northern Italy in September.

Notice has been received of the death of **Adon Smith II** of Charlotte, N.C. on June 22. He had been a leader in the field of profit sharing and pension plans in the insurance business for many years, and had been president of the Million Dollar Round Table and member of the American College of Chartered Life Underwriters. Surviving are one son, two daughters, and five grandchildren.—**William Meehan**, Secretary, 191 Dorset Rd., Waban, MA 02168

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A distinguished recognition has been given to one of our most accomplished classmates. **Nathan Cohn** has received the 1982 Edison Medal of IEEE "for a career of creative contributions and leadership in the instrument, control, and process computer industry, in the control and economic dispatch of power in large interconnected electrical systems." This award is still another recognition of his achievements with Leeds and Northrop Co. from which he retired in 1972. Our notes have recorded a series of awards to Nat in 1972, 1976, and 1977. We extend our congratulations. He and his wife, Marjorie, live in Jenkintown, Pa. and Scottsdale, Ariz.

David R. Knox of Lantana, Fla. sent greetings to our reunion and gave a further account of his activities. His wife Dorothy had to enter the hospital suffering from long illness and they had to cancel the reunion. Dave retired from Bundy Corp. as director of engineering, and was responsible for seven patents on tube manufacture. He was in politics and government in his hometown, Huntington Woods, Mich., and in 1948 was mayor for two years, served as chairman of City Planning and the County Traffic Safety Committee. He wrote a historical manuscript of life and times in our country from 1793-94 and presented it to the library. Related to Dorothy's loss of language ability from a stroke in 1964, he wrote a book, *Portrait of Aphasia*. He tells of regaining communication ability with his wife. It is widely distributed and had many fine reviews. Dave himself is restricted since 1977 by cervical spinal arthritis. In spite of these handicaps, he has taken up oil painting and has produced over 60 paintings. He donated many to their children's homes; two hang in their Palm Beach church; and two are in hospitals in Lake Worth. Dave has given us a fine example of facing physical obstacles yet making contributions in his retirement years.

Dr. **Frank G. Kear** is in Idylwood Convalescent Hospital, 1002 Fremont Ave., Sunnyvale, Calif. His wife Virginia sadly writes that he is very ill with Alzheimer's disease and she visits him twice weekly.

We regret to report the death of **Vernon G. MacKensie** on July 4, 1982 in Naples, Fla., who was buried in Arlington National Cemetery. As noted in the April 1982 notes, he had an illustrious career of 30 years with the U.S. Public Health Service. In addition, he held prominant government positions, including asst. U.S. surgeon general and deputy administrator of Consumer Protection and Environmental Health Services. In his retirement to Sanibel Island, Fla., he achieved the adoption of a land-use and growth plan and recently formulated legislation to control smoking in public places with the Right to Breathe Association. We extend our sympathy to his widow Alice and his family.

David E. Truax died on May 7, 1982 at Charlotte, N.C. He was an organic chemist and worked for 35 years in several management positions. When he retired, he was research laboratory director for the firm, part of Celanese Corp. Dave maintained a residence in Lake Worth, Fla. and was an ardent golfer. He was a member of the American Chemical Society and an active Mason and Shriner. For several years he was on a committee to interview high school seniors for M.I.T. Our condolences to his widow, Marjorie.

Bolick J. Shadrake died on February 9, 1982 at North Olmstead, Ohio. He was a senior design engineer with the Erie Railroad Co. in Cleveland. . . . **Charles H. Flohr** died on March 13, 1982 at Sunnyvale, Calif. His career was with the Home Insurance Co., and he was with their San Francisco office since 1959.

Further comments on our reunion. **Edward A. (Ted) Leach** from Springfield, Ill., says, "It was most enjoyable to see so many of the class. It is lucky we are through M.I.T.—we would never make it now." . . . **Chungsoo Oh** from Korea: "Although it was a brief encounter of three days, it gave unforgettable pleasure and memory of common ties during the good old Tech days. May we all expect to make another five years." . . . **Fred Willcutt** from Washington, D.C.: "Although I thought it was really a grand reunion, there was something special about the 55th. I think we all had a gratitude that we had been permitted to live this long and still had the health and strength to make it." . . . Our president, **Bud Fisher**, brought this out when he gave the invocation at two of our class dinners: "After all these years, I find classmates nearer and dearer. I thought the reunion to be especially well planned with ample free time."

Prentiss I. (Bud) Cole from Palo Alto writes: "Thank you for conferring on me the title of associate secretary for the Class of '27 for the western states. I will do my best to live up to your expectations. I was pleasantly surprised to read about men whom I have not seen or heard about in years. You have no idea how isolated those of us on the West Coast are from Institute affairs. From the printout I note out of 31 members of our class living in California 12 are within 30 miles of Palo Alto and 18 live in southern California, which is a different part of the world. However, I speak southern California dialect fluently since I have lived there for many years and do not intend to neglect this group. I for one appreciate the time and effort you have put into the class notes."—**Joseph C. Burley**, Secretary, 5 Hutchinson St., Milton, MA 02186; **Laurence B. Grew**, Associate Secretrary, 21 Yowago Ave., Branford, CT 06405; **Prentiss I. Cole**, Associate Secretary, 2150 Webster St., Palo Alto, CA 94301

28 55th Reunion

It will be close to the year-end when you have these notes before you. May we, then, wish all of you good health and pleasant holidays!

On occasion we are fortunate in receiving a good progress report from a classmate. **Frank Taylor** has had a most unusual career, and we are pleased to present the story in his own words: "On May 19, 1982 the secretary of the Smithsonian Institution and Mrs. Ripley were hosts at a reception marking the completion of the 60th year of my association with the Smithsonian. It was a real gala with some 300 guests including friends, associates, family, and neighbors. Mary C. Nichols, widow of **Arthur A. Nichols**, was my special guest. My daughter Joan, who heads the Department of Prehistory and Archaeology at the University of Liverpool, made a quick trip home for the occasion. Though I retired 12 years ago, I have retained an office in the original Smithsonian castle keeping moderately busy as a volunteer research associate of the Smithsonian Archives. I consult mostly in the history of the period of the Smithsonian in which I participated. Classmates who are good at arithmetic will realize that I was an employee of the Smithsonian (on furlough) when I joined the Class of '28. Starting as a laboratory apprentice out of high school, I became a non-professional historian of invention and technology which turned my thoughts toward becoming a patent attorney. To this end, I went to M.I.T. and later to Georgetown University Law School, L1B (now J.D.) '34. The late Philip Graham, then publisher of the *Washington Post*, remarked that this was certainly an unusual if not the worst possible training for a museum director.

"After World War II, I found myself leading a group of young professionals eager to create what became the Museum of History and Technology (now the National Museum of American History). With their help I undertook to write a prospectus for and to promote an enlarged museum and research program and later the program of requirements for the building to house it. I was the director of the new museum as well as of the United States National Museum of which it was a part. When the National Museum was dismembered into its large component museums, I was promoted 'to the shelf' as director general of museums.

"Mine has been a career unlike any I know. It has taken me to almost every part of the world working on basic museum concerns of national and international interest—at times under the auspices of the United Nations, Unesco, the International Council of Museums, the Ford Foundation, and national and regional museum administrations. I could not have planned it but certainly have never regretted it."

Thanks to a field visit by Bob Bliss (M.I.T. staff), we have an update on **Lawrence (Armie) Armstrong**. Armie is retired as chairman of Armstrong Machine Works (Three Rivers, Mich.), but he does have a new office which serves as a sales agency for the company, one wall of which is adorned with his M.I.T. Memorabilia. . . . Louise and **Ernie Knight** drove from Raymond, Maine to Philadelphia last spring for a visit with son David and family. This also provided the opportunity to visit with friends along the way. Ernie did some rowing on the Schuylkill and hopes to do some more on the Charles while he is in Cambridge for the 55th. . . . A good letter from **Ed Walton** says that he and Dodie were feeling fit after a winter holiday in Hawaii. They, too, have been visiting with their youngster families and were planning a vacation in northern New Hampshire for late summer. They look forward to seeing everyone at M.I.T. in June. . . . Pam and **Rene Simard**, who claim to be the youngest members of the class, report that their second youngest child, Brenda, has just graduated with honors in history from Queens University (Kingston, Ontario). The youngest child, Tim, still has two years to go at Toronto University. For travel, the Simards spent two weeks on St. John, Virgin Islands last year where they did some good sailing. . . . **Fritz Rutherford** wrote to give us his new address (available on request) and to assure us that he plans to be at the 55th in June. His health is good; he welcomes visitors; he still plays golf and will bring his clubs to Cambridge. . . . **Al Daytz** is pleased to announce that he became a great grandfather when Elisa Brooke Schneider was born on July 12, 1982. He noted that Elisa's grandmother, Lois L. Schneider (Al's daughter), also had her birth (December 6, 1929) announced in '28 class notes (February 1930 issue, in case you have your copy handy!). Our hearty congratulations to all participants!

Jacob Berkover reports that he is retired as district highway engineer for the Massachusetts Department of Public Works. . . . **Leon Gaucher** recently returned home from Florida. We are sorry to learn that Leon is having eyesight problems. . . . We have a nice letter from **Bud Wilber**, '26, who is an honorary member of our class. Bud and wife Lillian have had visits recently from Verna and **Rudy Slayter**, Dorothy and **Herm Swartz** and Libby and **Stew Newland**. The Newlands' decision to attend the 55th Reunion apparently was influenced somewhat by their talk with Lillian and Bud. As for the Wilburs themselves, they would like to attend and will if they can. We certainly hope they will join us.—**Walter J. Smith**, Secretary, 37 Dix St., Winchester, MA 01890

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By the time the November/December issue of the *Review* gets to you, we will have about 18 months before our 55th Reunion. No doubt you have received a letter that was sent by **Bill Bowie**, our class president, to all the members, in regards to your preference of time and place to hold our reunion. If you haven't sent your reply to **Jerry Gardner**, general chairman of the reunion, please do so. I have a note from **Fred Celler** of Maitland, Fla. and Puteaux, France addressed to the reunion committee which makes the following point. He suggests that, because many '29ers reside in south Florida or visit during the winter, it would be good to consider Florida (especially the February-to-April period). He favors the Orlando area, which has Disney's housing facilities.

Brigadier General **J. E. Howarth, Jr.** of Arlington, Va. is retired. Presently, he is the chairman of the board of trustees, Memorial Scholarship Fund, Second Marine Division Association. . . . **Jarvis M. Hazard** of Bellerose, N.Y. is still active and working in the electronics field. His job is inspecting and testing electronic component parts for a manufacturer of precision frequency-controlled devices. He has beeen employed for the past 11 years in the quality control department. He extends his warmest greetings to all '29ers. . . . **Sears L. Hallett** of Barrington, Ill. is still active and busy selling residential real estate. He was awarded the Million Dollar Sales certificate for the fourth consecutive year. He was appointed chairman of the Political Involvement Committee for the Illinois Association of Realtors. He is an active member of the Barrington Township Republican Club. The Halletts visited their son, daughter-in-law, and two grandchildren in Griffin, Ga. during the Thanksgiving (1981) holidays and their daughter, son-in-law, and two grandchildren in Ft. Collins, Colo. during the Easter holidays. They are both well and send their best wishes to all. The Halletts attended our 50th Reunion and were housed in a cottage which included your secretary and wife, **Larry Luey** and wife, **Robert Pride** and wife, **Hunter Rouse** and wife, **Neal Wells** and wife.

John G. Sullivan of East Dennis, Mass. has sent me a thank-you note and commendation for being a good class secretary. Last February he remarried a longtime family friend by the name of Lucille and they are looking forward to our 55th Reunion in 1984. John says, "I am still doing volunteer work at the Cape Cod Hospital, which I find most rewarding. Most of my leisure time is taken by golf, gardening, and the beach, and once in a while we break away and visit the outside world. We have lived in this lovely place for the past ten years, but I find that the myth that it very seldom snows here (and when it does, a broom will sweep in away) is true *provided* the broom is a sturdy power-driven type. Best of health to all until we meet again in '84."

Thomas W. McCue of Newton Highlands, Mass. is still active in his business of selling advertising in the periodicals of the New England Association of Fire Chiefs. "This work enables me to contact almost every type of business. My other activities are selling steel and other metals and equipment financing." Tom also participated in the 1982 Alumni Fund drive, devoting a few evenings to the telethons and calling classmates all over the country. . . . **Franklyn J. Lammers** of Highland Park, Ill. writes, "Recently, I became semi-retired to a consultant status. This year, on an Oriental trip, I hope to see Taj Mahal. I have visited Japan, China, Indonesia, South America, and Europe in the past. I find my chemical engineering and metallurgy still actively useful. Thanks for the birthday greetings. Best wishes to all." . . . **Charles B. Bacon** of Middletown, Conn. writes, "I am still very active and busy in my mechanical contracting business. Two of my sons are also associated with the firm, which lightens my workload. I am still chairman of the Middletown Water and Sewer Commission, a non-paying job which I have enjoyed working at for over 20 years. Last year, I received the Citizen of the Year award from our local chamber of commerce."

Maxine and **Milton Male** moved to Pampano Beach, Fla., where they are enjoying the gentle climate and the easy life. Recently, they celebrated their 50th wedding anniversary with a party given by their children. Their Wisconsin children and grandchildren also came to Florida for the occasion, and they had a great time. He ends his note saying, "Thanks for your birthday card and give my very best wishes to any '29ers you run into." . . . **Stephen Dilworth** of Largo, Fla. writes, "We have just returned from a 19-day cruise on the *Rotterdam*, through the Panama Canal. The trip ended in San Francisco, from where we flew to Tampa and home. We own time-sharing' on Sanibel Island, so we will be taking off again soon. Last year was a bad one for Myn, as she lost her daughter in New Jersey. She had to take many trips north to take care of her. We are looking forward to our 55th to see and visit old friends again. Regards to all."—**Karnig S. Dinjian**, Secretary, P.O. Box 83, Arlington, MA 02174

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This month's longest communication is from **Norman Dolloff**, who described in considerable detail a somewhat harrowing travel experience that he and Phyllis had in the spring 1981. Unfortunately, his colorful account of their tribulations must be truncated to fit the space limitations of this column. It seems that having previously visited east and south Africa, the Dolloffs signed up for a two-month trip to west Africa on a Jugoslav freighter. After relatively uneventful stops at Lagos, Libraville, and several Meditteranean ports, they reached the harbor of Luanda, Angola, to find it jammed with other ships waiting to unload. At the end of 55 days their ship had still been unable to discharge its cargo. Since Americans are not popular in Angola and the U.S. has no diplomatic representation there, they were understandably reluctant to go ashore. This reluctance was reinforced by tales of unpleasant things that happen to Americans who arrive in Angola without a visa. Finally, in desperation they went ashore ostensibly as Yugoslavs and began making the rounds of the European embassies seeking assistance. To compound their difficulties they ran short of cash and found that U.S. credit cards are not honored in Angola. Ultimately, the Italian ambassador arranged for them to fly to Kinshasa, where a benevolent U.S. diplomat accepted Norm's personal check to cover their air fare to Rome, where their return ticket to the U.S. could be used. Norm characterizes their junket as a "James Bond experience."

Irving Dow is an enthusiastic resident of Leisure World of Maryland, near Silver Spring, and a booster of its many advantages. He is on the board of directors of his cooperative, which houses about 900 people, and an active member of the Kiwanis, Camera, and Masonic Clubs. As an electrical engineer he is particularly impressed by the Leisure World annual energy consumption—62,780 MWH at a cost of $3.2 million. Irving says both **Ted Ross** and **Lou Verveer** have sons in the Washington area whom they visit about once a year, and he usually sees them during the course of such visits. . . . **Ralph Draut** retired about ten years ago after working 41 years in the aircraft industry, most recently on the supersonic transport for FAA. Ralph is an avid traveler and photographer. However, like some other amateur photographers, he has found it necessary to curtail his photographic enthusiasm for lack of storage space for slides and people to bore with them. He regrets that health problems made it undesirable for him to attend the 50th Reunion. . . . **King Tow** and his wife have recently moved east to live with their son James and his family in Holmdel, N.J., where James works for Bell Labs. As previously reported, King retired in 1972 from his job as a civil engineer for the El Dorado Public Works Department in Placerville, Calif. . . . We have at hand a sad note from **Hijo Marean** telling of the death last May of his wife Eleanor, after a second and massive stroke. She had been an invalid for the last three years. Hijo has given up his Boynton Beach, Fla. apartment and moved in with his daughter Carol in Dallas.

Also at hand are notices concerning the deaths of five more classmates: **Walter Parker** in Keene, N.H. on November 11, 1981; **William P. MacKusick** in Cleveland, Ohio on March 18, 1982; **Saul Sigel** in Manchester, N.H. on April 30, 1982; **Victor Gerdes** in Boynton Beach, Fla. on May 4, 1982; and **Hymen Shrager** in Lawrence, Mass. on May 8, 1982. Unfortunately, I do not have any information in my files about Parker, Gerdes, or MacKusick. Hymen Schrager grew up in Lawrence and attended Lawrence High School before entering M.I.T. For many years he lived in Natick, Mass. and worked as a textile chemist at the U.S. Army's Natick labs. After he retired he returned to Lawrence. . . . Most of the information I have about Saul comes from **Morris Shaffer**, who was a close friend and schoolmate of Saul's at Boston English High School before they entered M.I.T. After graduating Saul took a job in a silk dyeing plant in Gloversville, N.Y., where he learned a lot about the chemistry of dyeing fabrics. A few years later, at the suggestion of **Mannie Birnbaum**, he took a position as a dye chemist in the MKM knitting mills in Manchester, N.H., where in due course he assumed major administrative responsibilities. In later years he enjoyed spending time at a fishing camp he had built on a lake near Manchester "very reminiscent of that depicted in the movie On Golden Pond." Saul is survived by his second wife Selma, a well-known pediatrician, five children, and three grandchildren. My own recollection of Saul centers on our association in the Chemical Engineering Practice School in 1930. It was during this period that Saul, together with classmates Birnbaum, Ladd, Lu, Steffens, and Lister, contributed $5 each to the purchase of an ancient, commonly-owned Reo that carried all of us and our luggage from the Buffalo Practice School Station back to Cambridge.—**Gordon K. Lister**, Secretary, 294-B Heritage Village, Southbury, CT 06488

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Save the dates, June 14-18, 1983, for our Class of 1931 mini-reunion. A 14-day cruise to Alaska includes eight ports of call—an experience not to be missed. If you want more information, contact Polly and **Ken Germeshausen** at (617) 893-6090. In case you haven't received a notice of the mini-reunion, please drop a note to **Dave Buchanan**, our class president, or to me. A scroll was presented to Polly by your class officers for her birthday, and we extended to her best wishes from our class and expressed our appreciation for what she has and is doing for us.

Carrington Mason writes that he has retired as president, Texas Gas Association but is still with the Pipe Line Industry and BSA. . . . It is with sadness we report the death of **Chauncy Jerome Hamlin, Jr.** on April 16, 1982 in Lake Havasu City, Ariz. Chauncy graduated from Yale University and received his M.S. at M.I.T. in 1931. During his career, he was associated with the Jet Propulsion Laboratory in Pasadena and the Rocket Dyne Division of North American Aviation. At Rocket Dyne, he worked closely with Werner Von Braun on the development of the Redstone and Atlas Missiles. He is survived by his wife, Bernice R. Hamlin, and his family of children. Our sincere condolences to his family. . . . It is also with sadness that we report the death of **Spencer J. Buchanan, Jr.** on February 4, 1982. Spencer received his master's degree at M.I.T. in 1931 and was considered a world leader in geotechnical engineering. He was a distinguished professor at Texas A&M University and a consulting engineer in private practice for over 50 years. He is survived by two sons, Philip N. of Kemah, Tex. and Spencer J. of Guatemala City and four grandchildren. His wife died in October 1981. . . . A report has also been received of the death of Captain **James H. Rodgers** on June 10, 1981, but unfortunately we have no additional information.

A note from **Howard Richardson**, our honorary class president, says in part, "You asked for a little more detail on our trip to China last September. We visited Hong Kong, Xian (where the life-size statues of men and horse are), Peking, Shanghai, and Canton. We were impressed by the tremendous population explosion. There were very few automobiles, but

bicycles and horse-drawn carts filled the road. (Note, During our trip, we were told there are no private autos in the Peoples Republic of China.) Also, we were impressed by the difference in dress in the various cities. This September we plan to go to Egypt and then a three- or four-day cruise in the Greek Islands." . . . How about a note from some of you fellows who haven't ever written or from whom we haven't heard for years?—**Edwin S. Worden**, Secretary, P.O. Box 1241, Mount Dora, FL 32757; **John Swanton**, Assistant Secretary, 27 George St., Newton, MA 02158; **Ben Steverman**, Assistant Secretary, 8 Pawtucket Rd., Plymouth, MA 02360

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Our 50th Reunion class gift of $1,375,000 was one of the largest gifts ever made. The spark for the successful Alumni Fund drive was the $500,000 gift made by **Eric P. Newman**. Those of us who were able to spend time with him at the reunion agreed that Eric was a low-key, gentlemanly, forward-looking man, and that his charming wife Evelyn was of the same calibre. Because of hip injury, Eric became interested in naturally-controlled artificial limbs. M.I.T. was doing important work in this field. His gift established the Eric P. and Evelyn E. Newman Laboratory for Bio-Mechanics and Human Rehabilitation. The output of this branch of mechanical engineering is most prolific and important. Upon graduating M.I.T., Eric studied law. He became a lawyer and executive vice-president of Edison Brothers Stores Inc., which grew over the years to become the largest retailer of ladies shoes. Numismatics is one of his main advocations. He started collecting coins at the age of ten. He has gone deeply into the subject, written many authoritative books and articles which settled many century-old controversial problems. His latest book is *Early Paper Money of America*. Eric and Evelyn are world travelers and have lectured on their many trips to Africa and behind the Iron Curtain. Evelyn has written a most interesting series of travel articles for the St. Louis *Globe Democrat*. There are other fields of endeavor but enough for now. To the Newmans-our wishes that you keep up your productive activities!

On Technology Day there was a memorial service at the M.I.T. Chapel for those alumni that were reported deceased from April 28, 1981 to April 16, 1982. Those listed in the Class of 1932 are as follows: **John G. Cree, C. Milton Daniell, G. Donald Freeman, Richard R. Hall, Robert H. Hubell, Jr., Edward R. Levine, Frederick L. Mahoney, Earle M. McKellar, Donald I. McSheehy, George F. Meyer, Frederic I. Miner, H. Kelsea Moore, Louise S. Rousseau, Gardiner A. Smith, Farrow L. Tittle, Louis J. Vassalotti, Charles C. Wyatt**, and **John F. Yeager**.

We must also report to you the sad news about the following classmates. **Thomas F. Duggan** died July 1975; **Carrel J. Stover**, February 9, 1982; and Dr. **Meir H. Degani**, April 23, 1982. Our class condolences to the families of the above.

Charles Chapman writes that he is retired. He is now active in amateur radio. His call number is W43VB. He also enjoys cruises. . . . **George Goodman** writes that he recently celebrated his 36th wedding anniversary and his 35th year in the retail business in Newton Center, Mass. Congratulations and many more. . . . We have some extra 50th Reunion class books. They are available for ten dollars as long as they last. Write me.—**Melvin Castleman**, Secretary, 163 Beach Bluff Ave., Swampscott, MA 01907

33 50th Reunion

Headlines this time are for **Cal Mohr** and Course X, by far the most closely knit group in our time. Cal was the unannounced leader of that group. Members recently wrote to Cal, and he has forwarded their letters to me so we have news to start us up again.

Walt Swanton wonders how many of the '33 men are still active workers. (Walt, there are many who are still active, but most of the group own their own businesses.) Walt got word that the Saudi Naval Expansion Program was looking for someone to start up a hard chrome plating plant in Saudi Arabia. He looked into the prospect and was hired by a Los Angeles engineering firm to represent the prime contractor (of Tiawan) for one month. Walt advises that men of his age (just past 72) should avoid this sort of project, but to me Walt has a big amount of fortitude to accompany his long experience. Many thanks, Walt. We all appreciate your writing for the benefit of your classmates and your Course X bretheren. . . . **Beau Whitton** comes through with an inevitable controversy stimulated by a column in the *Charlotte* (North Carolina) *Observer*. Beau sent the article to the M.I.T. news service. I quote from it in part: "A professor at M.I.T. made $125,000 a year as a consultant for IBM. Another, at Stanford, started a firm that got a tidy $241,000 annually from AT&T. The controversy appears to be apparent, but we do not wish to compete, as one loses friends easily enough. Anyway, thanks, Beau.

A ceremony commemorating the railroad electrification program as an historic landmark was held May 22, 1982 in Cos Cob, Conn. The American Society of Mechanical Engineers (ASME) was represented by its president, Robert B. Gaither, and our classmate **Donald Fink** represented the Institute of Electrical and Electronics Engineers (IEEE), as its past president and director emeritus. The unveiled IEEE plaque read: "The alternating-current electrification of the New York, New Haven, and Hartford Railroad of 1907 was a pioneering venture in mainline railroad electrification. The major components were developed by the engineering staff of the railroad and Westinghouse Electric and Manufacturing Co. of East Pittsburg, Pa. Direct current was eliminated entirely by the new system of single phase alternating currents. Following the success of this system, a number of other railroads applied the system to their operation—Norfolk and Western, the Virginian, Boston and Maine, the Great Northern, and the Pennsylvania." If interested, I'm sure you could get a full account of this story by contacting either of the professional societies.

We have two replies to my letters "crying" for personal news—one from **Jack F. Andrews** and another from Helen and **Bill Baur**. Since retirement, Jack has been acting as a consultant, which consists of finishing a project he was working before retirement. Golly, that's a new wrinkle! With his increased spare time, Jack is able to play more tennis, put much more time into his garden, and study wild flowers. In addition to this he has started and finished another project—he spent a month studying all makes of new domestic and foreign cars, and wound up buying a Buick Le Sabre. Jack was recently elected to the Village Civic Association of Lawrenceville. Jermain is still teaching, but in a new private school.

When Jack returned from his summer vacation, he found a letter from **Dick Molloy**. Dick, who lives in Sun City, Fla., has retired from his position with United Technologies (United Aircraft). Dick drives right by Exeter to get to Cushing, Maine, his summer address. (I must remind him that the *Review* carries my address at the end of each column.) . . . Jack comes up with another tidbit. **Mel Ehrlich** completed his term as president of the Princeton M.I.T. Club, and they were honored by having our president, Paul Gray, attend their spring dinner. Golly, that fellow Jack writes a newsy letter; and, Jack, I thank you ever so much.

Bill Baur says that he and Helen drove to New England in May to attend a triple wedding anniversary—their son's, their daughter's, and their own. They took a different return trip, through Vermont, Quebec, Montreal, and the Laurentides. Bill is now attending the Philadelphia Club affairs, which club will soon host the early fall Alumni Officers' Conference. Bill is looking forward to the spring festival near Disney World. Later they expect to visit again, the family in Amherst, N.H., and Dracut, Mass. Bill, many thanks, and look up **Clarence Farr**, in the Nashua phone book.

Three of ours have gone to their reward since last issue. **Gilbert W. King**, of Los Angeles, Calif., passed away July 10. I wrote Mrs. King, and she replied, which is a bit unusual. Her letter was lovely, and it takes its place with one I received from **Duke Selig**'s daughter soon after Duke's passing. . . . Two other deaths reported were **Ronald A. White**, architect, and **William P.M. DeCamp**, Course II, mechanical engineering. No more details.

That's it for this time around. Sure glad to have something real to write about, but, fellas, don't make me write to the more faithful for class notes. Just let **Jack Frost Andrew**'s reply be an example.—**Warren J. Henderson**, Secretary, P.O. Drawer H. Exeter, N.H. 03833

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I've had my vacation at George Bull's expense (for notewriting, anyhow) and so it's time to get back to work. . . . Our seven-week trip to Europe (from mid-April to early June) finally came off, with only one glitch. We were able to see our friends in Haarlem, The Netherlands, before they finished their overseas assignment and came home. The spring had been cool and we were a little early for all the tulips. However, this was the year for the "every ten year" Floriade, held just outside Amsterdam, and between that and the Keukenhof Gardens at Lissle we saw some beautiful flowers. Our friends also took us to see Utrecht and The Hague, both interesting cities. We spent a few days in Brussels and Bruges—the latter probably the most memorable single thing that we saw. Bruges still retains many of its medieval buildings and was fascinating, especially when we happened to be there for the Saturday market—all against a background of 15th century guildhalls. We went on to a week in Paris. The weather was cloudy and cool, but it is always a wonderful city to be in. It also gave me a chance to ride the new high-speed train to Lyon. It didn't quite get up to its advertised 260 kilometers per hour, but with its new roadbed it was amazingly quiet and steady at the 200 kilometers per hour it did reach. There was about a month for England, and after a week in London we rented a car and headed south to visit friends and then to Kent to see a number of the great houses there. We then went looking at cathedrals and old cities in Norwich and Lincoln and on to visit other friends in the Cotswolds. And that's where the "planned trip" ended. On a narrow country road I overshot the lane to our friends house and had to go another 150 yards to find a place where I could turn. I did so by wyeing back, but when I went ahead force of habit took over and I stayed on the right-hand (wrong) side of the road. Unfortunately, before I realized it, I came around a sharp curve and ran head on into a poor soul who was just where he belonged. Luckily, neither of us was going very fast so there were no injuries. So at my friends suggestion, we ended up spending a week at Torquay on the Devon coast, for a rest from our sightseeing. Our hotel room had a lovely view of Tor Bay, and we saw Devon and Cornwall from tour coaches—"took the bus and left the driving to them." It's not a bad idea on the roads down there. . . . If you will remember, June was when the British were gearing up to get their forces to the Falklands. It was quite interesting to see how everyone except the really radical fringe of the Laborites were united behind the government.

Enough already about our travels. With the hiatus of my being away, some things seem to have piled up. One is a letter from **Proctor Wetherill** with some comments and ideas for our 50th Reunion. Proctor has been growing Christmas trees since he left the paint business, and he included two of his leaflets from last year. He has a really sizeable operation going—200 acres with almost 300,000 trees, mostly Douglas firs. . . . I also have a note from **Hank Backenstoss** telling me that **Art Conn** has retired from Indiana Standard and has been engaged in his own consulting business since then, "as a means of sipping from the fountain of youth."

Unfortunately I must report the deaths of two faithful class members. On March 31 **Charlie Sheehan** died in the Blue Hill Convalescent Home after a long illness. He was the retired president of the General Fiber Co. in Walpole and a former selectman of Stoughton, where he had been a lifelong resident

and active in civic affairs. He is survived by his wife Mary, three sons, a daughter, and four grandchildren. Those of us who have attended reunions will remember that Charlie was one of the faithful attenders. We'll miss him at our next. . . . Our other loss is that of **Del Keilly**, who had retired from the Institute in 1973 as associate professor of meteorology. He had specialized in aircraft and meteorological instrumentation during the years at M.I.T. He died at home on June 16 at Lincoln. Del had been an active sailor and had worked with the Boston Sea Rovers. According to **Ray Jewett** who knew him very well, it was on a Sea Rover trip that Del suffered a head injury that led to brain damage and his partial paralysis. He was just recovering enough at the time of our last reunion that Ray and Olga could bring Del and his wife Gertrude down to the Cape for our party. My prime recollection of Del goes back to our 25th Reunion. It was gloomy and overcast when we arrived at Baker, and Del was there to greet us with, "Sorry, fellas, it's going to be a lousy week-end for weather." And that's one weather forecast that was 100 percent on the nose! . . . To both Mrs. Sheehan and Mrs. Keily and their families, I would extend the sympathy of all our class on their losses.

There are also some Alumni Fund notes to include this month. A somewhat poignant one from **Walter McCutcheon**: "Bad news and good. Carlotta had a fatal heart attack on December 5, after 42 happy years. Daughter Gail (Ph.D., Stanford, 1976) is an associate professor at Ohio State, teaching summer school this year at Victoria University on Vancouver Island. Son John has just finished his pursuit of an Ed.D. at Indiana University. I am still active with the local sewer authority on a volunteer basis." A wife's loss leaves the same kind of emptiness as does a husband's, who I so often have to report and I am sure we all wish Walter the same sympathy. I would hope his children's careers would offer some solace to fill the gap.

In the midst of writing these notes (August 24), the M.I.T. Club of Cape Cod had a picnic meeting that almost provided a '34 mini-reunion. With our wives there too, there was myself, **Ralph Brown, Ray Jewett, Earl Lockhart**, and down from Wellesley for the day, **Tom Burton**. Ray, Tom, and **Larry Stein** in Hingham are all radio hams and run a regular network. Tom says that recently they have added **Graves (Bud) Snyder** in Summit, N.J. It also turns out that when I was in the hospital last year, Tom kept checking, even talking to the nurses, and passing on status reports to the others. I never knew it until today!—**Robert M. Franklin**, Secretary, P.O. Box 1147 (620 Satucket Rd.), Brewster, MA 02631; **George G. Bull**, Assistant Secretary, 4601 N. Park Ave., Apt. 711, Chevy Chase, MD 20015

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In the last notes I reported on **Ed Taubman**'s mini-reunion on June 27 in Baltimore. **Randy Antonsen** and **Ned Collins** have the Boston area one set for September 11 at Endicott House in Dedham, and I shall report on that to you in the next notes. Hopefully, we will have some others to tell you about also.

I received a letter from **Bud Pflanz** about six weeks ago that got mislaid in my moving, but even in November and December it will not be outdated. Bud writes, "Greetings from Sierra Vista, Ariz., where I am now sponging on my son-in-law and my number two daughter. My son David, who was in that horrible auto accident in December 1980 went back to college in August 1981 and improved sufficiently, both mentally and physically, to graduate this past May with a B.S. in engineering construction. He flew east to help me drive west in my new little Dodge Omni 024, towing a small utility trailer with our luggage, as my two dogs occupied the rear seat of the Omni. Since a ladder and I had a disagreement in October 1981 resulting in five broken bones in my right foot, I resigned as the neighborhood friendly Mr. Fixit. To further deflate said image, I disposed of my great big station wagon, thereby convincing my neighbors and friends no longer was I at their beck and call to deliver and haul. So here I am out West trying to acclimate my ancient and honorable bones to 95 degrees, 20 percent humidity and 4,500-foot elevation, as contrasted to New Jersey's 95 degrees, 100 percent humidity and 100-foot elevation. Expect to spend the summer between here and Albuquerque, where my number one daughter lives and return to Jersey soon after Labor Day. Who knows, I might even decide to move to the Southwest. Son David upon graduating from Arizona State has accepted a field supervisor position with a home building corporation in Phoenix at $20,000 per year. So all three of my children are in the Southwest area."

Notes by way of the Alumni Fund Office came from **Louis Fong** who reports, "Retired in early 1980, but am involved in management and technical consulting, which keeps me busy. Recently returned from trips to Hawaii and Europe. Looking forward to our 50th." . . . And from **John Alden** who writes, "I have recently joined the Milwaukee Road Railfan Association. My particular interest is in construction of line through the Bitter Root Mountains and its electrification. In my spare time I work on my H.O. model RR. Also enjoy birding, square dancing, contract bridge, and climbing." . . . **Frank Hatch** writes from Palo Alto, "Our older daughter is back in South Carolina with her sister. Younger daughter's husband recently was appointed squadron commander." . . . **Sid Grazi** appended a paragraph to his gold score card, "Although I'm supposed to be retired to some degree, it seems I'm putting in more time off the golf course and either at the office or on business matters even away from the office."

I am sorry to report to you the following deaths. In the fall of 1981, **Joseph A. Simendinger, Jr.** died in Stratford, Conn. He was a member of Sigma Nu. **Damon E. Francisco** of Taunton, Mass. died February 7, 1982, a chemical engineer at Union Carbide until his retirement. **Priscilla Bunker Maury**, for 28 years a chemist with the National Institute of Health's National Cancer Institute, died of cancer on February 12, 1982, leaving two sons, two daughters, and 15 grandchildren. **Carbon C. Dubbs** died suddenly on April 7, 1982, as reported by his widow from 2042 Fairweather Rd., Santa Ana, CA 92705. On June 17 **Thomas F. Morrow** of Grosse Point, Mich. died. He was a member of the M.I.T. Corporation from 1963 to 1968 and was formerly a group vice-president of the Chrysler Corp.

To end on a happier note: the Mowatts third granddaughter arrived on July 27. Katie was born to Kay and Christopher Mowatt, giving them a family of two girls. Still in the running in the Class Golf's 22nd tournament are **Al Johnson** (last year's champion), **Sid Grazi, Chet Bond, Bob Flood, Sam Brown, Bill Cross, Ken Finlayson**, (last year's runner-up), and **Dick Bailey** (low handicapper of all of us). . . . I hope you and yours have a Merry Christmas, Happy Hanukkah, and Happy New Year.—**Allan Q. Mowatt**, Secretary, P.O. Box 92, Newton, MA 02195

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Last issue I reported the death of **Benjamin Cooperstein** unexpectedly last May 27. Since that writing I have had a nice note from Florence giving more information than I had then. Following graduation Ben joined Clear Weave Department Stores as an administrative executive. During the war years he was plant engineer at Ratheon and then joined W.A. Emery Co. of Waltham where he was president and general manager. The firm contracted and engineered plumbing, heating, air-conditioning and process piping. Recently, Ben had been doing consulting. Over the years Ben had been very active in PTA, Beth El Temple, and the support of various hospitals. I could perhaps add more but I think this is sufficient to let us know that Ben was a responsible, solid member of the greater Boston community. Ben and Florence were not married until 1955, so their family of eight is somewhat younger than many of our class offspring. Of the seven living, they are a social worker, a law student, a budding teacher, a public relations and computer person, a student nurse, a University of Massachusetts student, and a junior in high school.

Word has come of the death last April 24 of **John P. Hayes**. He was retired from McDonnell Douglas Corp. and had made his home in Palos Verdes Estates, Calif.

On a more cheerful note, **Mac Nyhen**'s daughter graduated from Barnard last year, and his son will be graduating from George Washington University this coming year. It's always good to see the end in sight. Mac continues with the Bureau of Industrial Economics in the Department of Commerce in Washington. . . . **Stephen Richardson** was tendered a dinner in his honor and awarded a certificate of appreciation for dedicated service to the profession and the community by the Seattle Chapter of the American Institute of Architects. He has been a practicing architect in Seattle for many years.

I have been giving some thought and would like your thinking on the goals for our 50th Reunion. Somehow, I suspect we need to devise a plan which will allow for a high level of participation and not just a luxurious house party for those who can afford it. I will welcome your ideas, and by the time you read these notes those who made it to West Hartland on October 30 will have had an opportunity to respond in person. I will share their ideas with you all.—**Alice H. Kimball**, Secretary, P.O. Box 31, West Hartland, CT 06091

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George Randall, 39 Summit Place, Newburyport, Mass., retired in 1978 after 41 years as director of development with the Badger Co. (a subsidiary of Raytheon), Cambridge, Mass. For the next nine months he consulted for the U.S. Department of Energy in a project managed by Course X at M.I.T. His entire 41 year career was in chemical engineering. He is enjoying his retirement. He and his wife Grace regularly square dance, and they play duplicate bridge twice a week. As a hobby he assembles stained glass sun catchers and lamp shades. Much of their traveling (Kenya, Egypt, New Zealand, Tahiti, Fiji, Malasia, China, Thailand, Philippines, and various islands in the Caribbean) has been with square dance groups. His son George, Jr., '66 (Course X), after six years with Sinclair Oil in Chicago returned to M.I.T. for his M.S. in chemical engineering and went to work for the Cabot Corp. He is now assistant manager of their distri-gas terminal in Everett, Mass. George, Jr. has two daughters and four grandchildren.

Michael Zinchuk, 145 Gofnold St., Hyannis, Mass., retired from Polaroid Corp. in February 1982. After graduation he went to work for Cities Service Refinery and then attended Harvard, where he received his M.S. in communication engineering in 1939. He then filled progressively responsible positions with Bethlehem Steel, Wright Patterson Air Force Base, Lincoln Laboratories, Standard Electric Time, Baird Atomic, Barkley and Dexter, and finally Polaroid Corp., 1969-1982. At Polaroid he did research and development on non-mechanical shutters and research on photometric and radiometric measurement methods, modems for sending and receiving sound, and displaying film on television. While at Wright Field he was the author of an Air Force publication *Limitations of Microwave Communications*. He acquired a number of patents on antennas, receivers, oscillators, televisions, electro-optical chemicals, and infra-red range finders for cameras. Michael's hobbies are, fishing, woodworking, photography, home maintenance, sewing, leathercraft, and anthropology. He plans to do some consulting. He holds membership in the Institute of Electronic and Electrical Engineering, Society of Information Display, Committee on Optical and Radiation Measurements, and is a U.S. Representative to the International Committee on Illumination. His wife Ann enjoyed teaching English for 23 years and retired when Michael's job required them moving to Springfield, Mass. Six years later she started a second career working parttime for the Watham Hospital in Waltham, Mass. in the admitting office and at the reception desk. For the past two years she's been a volunteer there. Upon request she twice led pre-retirement seminars on "Meaningful Use of Leisure." She believes one can be glad or sad, and glad's better. Two years ago Michael and Ann drove 11,400

miles in six weeks to the Canadian Rockies, Lake Louise and almost all the national parks, down to the Pacific Coast, across the Mojave Desert and visited many Indian reservations. They are planning another trip in the spring of 1983, taking a southern route. Right now they are busy updating their Hyannis current permanent house where they have spent many weekends for the past 28 years.

H. Arthur Zimmerman, 3356 Lansmere Rd., Shaker Heights, Ohio, was recently appointed executive director of the revitalized Cleveland Commission on Higher Education. The commission includes eight colleges and eight civic leaders representing the business community. Art faces a real challenge since the commission has been without an executive director since 1979. Art retired in 1982 after 25 years as a vice-president of SIFCO Industries, Inc. and 35 years with the company. He was also a sales manager and engineer. . . . **Duane O. Wood**, 920 Linda Flora Dr., Los Angeles, Calif., writes, "After retiring as president of Lockheed California Co. in 1976, I did a number of consulting jobs and then became executive vice-president of Triad Holding Corp. in London for two years. After retiring the second time, I returned to Los Angeles. My wife Beverely died of cancer a year and a-half ago, and I am now devoting most of my time to consulting work for firms doing business in the Middle East." . . . **William J. McCune, Jr.** of Lincoln, Mass., president, chief executive officer, and chairman of the board of Polaroid Corp., has been elected chairman of the board of trustees of the MITRE Corp., a systems engineering company headquartered in Bedford, Mass. He has been a member of the board since 1968 and the executive committee since 1969. During his 14 years of service with MITRE, he has served on and chaired numerous board committees and studies. MITRE, founded in 1958, has nearly 4,000 employees. Its main clients are the Department of Defense and other federal and civilian agencies. . . . **David F. Tuttle** writes, "Spent 1981 and 1982 as visiting professor of mathematics of Georgia Tech in Atlanta."

It is with deep regret that I report the following deaths. **Louis C. Bartol**, 1460 Canton Ave., Milton, MA 02186, died May 6, 1982 and is survived by his wife, Phyllis. **Philip C. Jacobs, Jr.**, 53 Walden St., Newton, MA 02160, died July 15, 1982 and is survived by his wife. **Charles E. Ryan**, 421 Concord Rd., Bedford, MA 01730, died July 28, 1982. He is survived by his wife Rose Mary, two sons (Michael and Charles of Bedford), and two daughters (Loretta, of Lowell, and Laurie Zimmer, of Tewksbury). **Allan M. Swift**, 2903 Wild House Rd., Orlando, FL 32807, died February 27, 1982 and is survived by his wife.—**Lester M. Klashman**, Assistant Secretary, 198 Maple St., Malden, MA 02148; **Robert H. Thorson**, Secretary, 506 Riverside Ave., Medford, MA 02155

38 45th Reunion

Don Severance, as chairman of our 45th Reunion, has things well in hand. The Boston Pops on Thursday, June 9, is the kick-off, with Technology Day in Cambridge on Friday, and a full retreat to my part of Massachusetts—the Wianno Club in Osterville on Cape Cod, where that night we'll have cocktails and dinner. Saturday will include golf and tennis, with croquet and bridge for the infirm, interspersed with a noonday clambake and a class dinner that night. The program will be concluded with a brunch on Sunday.

Because many of us are retired, the committee anticipates the largest attendance to date. For those of you in the remote hinterlands, this offers an excellent opportunity to revisit Cambridge and old Cape Cod and to renew long-standing friendships.

Frank Atwater, former chairman and president of Textron's Homelite and Fafnir Bearing Divisions, was elected a director of Cronus Industries in Dallas. Cronus manufactures metal buildings. . . . **Fred Ray** writes that, after retiring from Mobil last year, he continues to do some consulting on oil shale retorting, but expects to cut it off and "succumb to hedonism." . . . **Clark Robinson** continues to edit the *Soviet Journal of Nuclear Physics*. Before you get excited, this is a translation journal published by the American Institute of Physics. . . . **Gus Rossano** became professor emeritus at the University of Washington in Seattle last year, but continues to teach two graduate courses. . . . **Bob Solomon** is clinical professor of pathology at the State University of New York. He recently returned from a trip on a Nile riverboat, rediscovering its source.

Remember **Johnny Wallace**, president of 1938 in 1938? We lost track of him, but he recently showed up in the *Wall Street Journal* as chairman of Prab Robots, Inc. and president of Prab Conveyors, Inc. in Kalamazoo, Mich.

Sandy joins me in wishing each of you a very merry Christmas and a happy New Year.—**Armand L. Bruneau, Jr.**, Secretary, 663 Riverview Dr., Chatham, MA 02633

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Harold Pope, chairman of Sanders Associates, Inc., was honored again by being elected to the Daniel Webster College board of trustees. Congratulations, Harold, on this and on M.I.T.'s Corporate Leadership Award. . . . **Dick Novak** was named a fellow of the American Society of Mechanical Engineers for his significant contributions to the field of engineering. Dick's career includes associations with General Electric Co., Pratt and Whitney Aircraft Co., and accomplishments in the development of aircraft engine compressors.

Billie and **George Cremer** completed a 13,000-mile around-North America trip in ther luxurious motor home and they relay the following newsbits about their visits to three classmates. . . . Hazel and **Walter May** parked the Cremer motorhome at their Allentown, Pa. residence on the day after Walter retired as executive vice-president from the Mack Truck Co. More than 500 wellwishers had assembled the night before at a gala banquet to honor Walter and Hazel. Several thousand customers and associates sent goodwill presents, including a garden tractor on which was mounted a large golden bulldog (the mascot emblem of Mack trucks). If Walter pulls an "Alexander Botts" when plowing his yard by involuntarily plowing his neighbor's flower beds, you may expect a further news report in these class notes about the "Walter Mays in Retirement." . . . Dotie and **Bob Casselman** were next to park the Cremer motor home, at their Cataumet Cape Cod home. We are all delighted to learn of Bob's steady progress and Dotie's loving accomodation. . . . **Bob Youngquist**, near Washington, D.C., was next to host the Cremers. Bob's career achievements being in the area of small missiles and rocketry, this visit included a stop at the Smithsonian Institute where the fascinating displays included elements of engineering and hardware to which Bob and George both contributed.

In the meantime, Hilda and I completed a 4,000-mile trip up the whole U.S. West Coast and into northern Idaho. In Seattle, Mary and **Jim Barton** prepared delicious barbecued salmon at their lovely home on the shore of Lake Washington. Hilda and I drove on eastward to Lake Williams, near Spokane, where two rainbow trout volunteered to hang onto my line. As they came aboard, they were heard to say, "You know, we wouldn't have gotten ourselves into this mess if we had been smart enough to keep our big mouths shut." Having come to this reference about shutting, it's time to close off this edition of class notes.—**Hal Seykota**, Secretary, 1603 Calle de Primra, La Jolla, CA 92037

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News is limited for this edition. However, news clippings did provide some good, as well as some sad, news.

Ralph Millet, who was responsible for the entry of the Swedish-made Saab cars into the U.S. in 1956 and was first president of the importing company, has been named a member of the board of directors of Saab-Scania of America, Inc. Active as a representative for the imported auto industry in Washington, Millet is chairman of the Automobile Importers of America, representing almost all importers of cars to the U.S. He was a member of the National Motor Vehicle Safety Advisory Council, an advisory group to the Secretary of Transportation, from 1969 to 1976. He is also a member of the board of directors of the Union Trust Co. in New Haven, and Fortune Plastic, Inc., in Old Saybrook, Conn. Ralph is a resident of Old Saybrook, where he is also quite active in local community affairs.

Louis Tura writes that he is still with Lone Star-San Vel as field service manager. . . . **Leonard W. Weaver** of Walpole, Mass., founder and retiring director of the Neponset Choral Society, was honored at a dinner-dance by members and friends of the society. Leonard recently retired as manager of the Technical Center of Bird and Son, Inc., in Walpole, Mass.

Frank G. Denison, of Santa Maria, Calif., died on May 18. He is survived by his widow, Ruth. . . . **Dick Talpey**, now a retiree from RCA and living in Mirror Lake, N.H., sent me a note indicating that **Charles Goddard** had died at his home in Pleasant Valley, Pa., on May 21, after a long seven-year battle with cancer. Charlie had spent his working career with Bell Laboratories at various locations. The latest was at the Quakertown, Pa. facility. He is survived by his wife, Mildred, and two children—daughter, Sheridan Waller, and son, William. . . . **Stanley Hurley**, of the Magnolia section of Gloucester, Mass., died at his home on June 19, where he had lived since 1942. He is survived by his wife, Jane, and daughter, Jill. He has retired from the First National Stores in Somerville, Mass.

Norman Klivans has made an advance deposit for rooms at the Woodstock Inn for our 45th Reunion. In addition, he has made tentative arrangements with the Hyatt Regency on Memorial Drive in Cambridge, reserving rooms for Wednesday and Thursday nights, June 6 and 7. I'm collecting statistics on number of grandchildren, great-grandchildren(?), etc. Please let me hear from you.—**Donald R. Erb**, Secretary, 10 Sherbrooke Dr., Dover, MA 02030, (617) 785-0540

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Alan Katzenstein, quoted in *Current Controversy* from his *Updated Prospective On Acid Rain*, summarizes the problem: ". . . It is far too early for responsible people to suggest that the feared consequences of precipitation acidity are unreal and will never be proved, but is also too early to resort to the proposed corrective strategies without evidence of their probable effectiveness." Between Alan and **Shep Tyree**, we are getting a play-by-play follow up of this problem for sure.

Two retirements this month—**Wallace Murry** retired as a director of Golier, Inc., in Danbury, Conn., and finally **Jesse Van Wickel** reported his "retirement" in 1975 after 33 years at Lockheed. Jess then reports that after six months he went back to work half time as an "administrator." In 1980 he went back to more work as a technical editor at Pacific Southwest Airlines. Jess' final comment is that Course XVI prepares one for any career.

We note with sadness the passing of Dorothy (Mrs. **Floyd**) **Lyon** on the Friday of our reunion weekend after a valiant battle with leukemia. Dorothy was present, with Floyd, at every one of our principal reunions. She surely contributed to our class' spirit and style as though she were actually a member. We will miss her. Our sincerest sympathies go to Floyd and to the family.—**L.K. Rosett**, Secretary, 191 Albemarle Rd., White Plains, NY 10605

43 40th Reunion

Dick Feingold writes from Palm Springs, Calif. urging me to enjoy my stint as writer of the class notes. I get the impression he likes it more the further back he stands. Dick is now a lecturer in construction law at the University of Southern California. He finds this job and the local construction law cases much less rigorous than his former duties with the Connecticut Attorney General. He claims, however, to be fully oc-

cupied in his new status as a bachelor. Dick compliments **Jim Hoey** on the choice of the Cape Codder Hotel in Falmouth for our 40th Reunion. It is near the site of our 15th Reunion at the Royal Megansett.

Dick also reports seeing Lenore and **Bernie Brindis** during their search for a winter home near a golf course. They ended up at Rancho Bernardo (where else?), near San Diego. Further news was relayed by Dick from **Larry Stewart**. The story goes that in 1980 Larry visited the Olympic Games stadium in Greece, where he changed into his M.I.T. track shirt and shorts and ran a couple of laps. Dick says Larry has photos to prove it.

Hans Haac retired from duPont June 30. He now fills his time with "taking it easy," teaching at Delaware Technical and Community College, sailing, and "honey-do" jobs. People like this sure do spoil it for those of us who plan to retire in front of the tube.

As you know, this is the final year of our 40th Reunion gift campaign. Our objective is to fully fund the Class of 1943 Career Development Professorship by June 1983. To achieve this objective requires gifts and pledges totalling $500,000. To date we have raised approximately $250,000—leaving a balance of $250,00 still to go. There are many ways you can make a reunion gift—cash, securities, stock in a privately held company, insurance policies, living trust arrangements, etc. Also, you may pledge your commitment over a five-year period, thus making the payment schedule flexible to your particular circumstances.

Stan Proctor, gift chairman, and members of the gift committee will be calling upon you to make a maximum commitment. The Class of 1943 can boast no one major donor to this project—it must be a class effort with every person making a gift commensurate with his or her ability. Please consider your commitment seriously. If you have any questions about a particular gift arrangement, call Stan at (216) 425-7814 or the Alumni Fund Office at (617) 253-8215. Also, consider becoming a Sustaining Fellow ($2,000 gift or $10,000 pledge over five years) or a Great Dome Associate ($250 or more annually).

On this, the 20th day of August (my birthday), I wish you all a Merry Chirstmas.—**Bob Rorschach**, Secretary, 2544 S. Norfolk, Tulsa, OK 74114

44

Happy Thanksgiving, Happy Chanukah, Merry Christmas, and Happy New Year. Once again we have arrived at that time of year for family reunions and for the perpetuation of family customs and traditions. May fate be kind to you.

While reading my *Review* for May/June, I found that **Holten E. Harris** of Westport, Conn., had visited the VI-A office at M.I.T. about the time his son Walter had received early admission to M.I.T. for this fall. Congratulations to another graduate for inspiring the next generation to attend the Institute. . . . **Warren E. Mathews**, who has been with Hughes Aircraft Co. for more than 30 years, was recently appointed staff vice-president, product effectiveness. He had been directing product effectiveness activities since 1975 and previously had served as director of corporate planning, director of the infrared laboratories, missile systems division manager, and assistant executive of the company's Electro-Optical and Data Systems Group. . . . **A. B. Van Rennes** sent us a "news flash" through Institute channels relative to his current activities. As of August 30 Van and his wife Eve are residing at Apartment 1701, Ratu Plaza Apartments, Jalan Jendral Sudirman, Jakarta, Indonesia. Van recently retired from Bendix and has signed a two-year contract with the U.S. Agency for International Development to serve as senior advisor to the Minister of State for Research and Technology, Republic of Indonesia. His job will emphasize the building of links with U.S. industry in order to establish manufacturing jobs in Indonesia. Eve is on leave from the Cranbrook Institute of Science and is hoping to obtain an A.I.D. grant to investigate computer projects in museums or science-curriculum assistance for Indonesian primary education or computer-literacy classes or other needed studies.

Marguerite and **Ed Ahlberg**, Anita and **Les Brindis**, Jane and **Lou Demarkles**, Janice (Mrs. **Malcolm**) **Kispert**, Ruth and **Norm Sebell, Melissa Teixeira**, Doris and **Chet Woodworth** met at the home of Edna and **Stan Warshaw** for dinner and to discuss the latest news about our 40th Reunion plans. The Warshaw's reported that 50 rooms have been set aside for us at the New Hampshire resort, Wentworth-by-the-Sea, for Saturday June 9-11, 1984, with an option for June 12. This is after the on-campus activities of buffet and Pops concert on June 7 and the Technology Day program on June 8. Plans were also made for a mini-reunion to be held at Martha's Vineyard in May 1983. The next class notes will give the dates and location. Hope you can attend this event.—**Melissa Teixiera**, Secretary, 92 Webster Park, West Newton, MA 02165

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If it's okay with you (my captive audience) I'll dedicate this column to what I fondly think of as "The Three Sisters." They are not only classmates but coursemates of mine.

Pauline Glazier Teague, Betty Bunte Stevens, and **Beverly Beane Graham** just had their own 36th reunion in July at Beverly's home on Shaw Island in the San Juan archipelago north of Puget Sound. How do I know all this? Well, because Pauline and her husband, John, stopped by our place on their way east to Belmont (Mass.) where she'll join with her four sisters in celebrating her folks' 60th aniversary!

Pauline's been "retired" since the mid sixties, after toiling in the field for about 20 years, and John retired about six years ago. Since then they bought a house in Borrego Springs (in the desert east of Mt. Palomar) and built a house outside Fallon, Nev., where they spend the hot half of the year. She learned to fly about 12 years ago (give or take), thus fulfilling a lifelong ambition, and takes off whenever she puts enough pesos together. Kid's got a "lotta moxie," as we used to say.

Beverly, "a real brain," got her Ph.D. in aero, and some time thereafter went to Seattle where she met her husband, Ernest, a fluid dynamicist of some note. They've joined forces as an "associate" team and have cranked out such esoteric monograph's as, "The tank wall effect on internal waves due to a transient vertical force moving at fixed depth in a density-stratified fluid." But I'll let Beverly tell it in her own words: "Usually I work with Ernest, who has lots of ideas for various fluid mechanics problems of interest. But also I've discovered small computers, and right now I'm working part time at software design and programming for Shaw Island's only industry, Northwest Marine Technology. NMT makes coded wire and sophisticated electronic equipment for tagging fish, thereby enabling the collection of data to provide knowledge useful in protecting and enhancing one of the world's important food supplies. As everyone knows, fish are the original fluid dynamics experts. Working for fluid dynamics experts has been my good fortune for nearly all of my adult life!"

Meanwhile, Betty, who moved to Southern California about the time Pauline did in the late forties, met her husband, Bill, when they worked together at Northrup, if memory serves (and it usually doesn't). She "went off line" not too long after their marriage and has been happily home managing every since. Pauline tells me Betty's been a serious dancer since day one and is now working hard at her tap dancing. She and Bill, who's been retired for some time now, have lived in Sherman Oaks for lo these many years. Her's and Pauline's addresses can be furnished on request. Beverly's you'll have to find for yourselves. . . . Take care and keep in touch!—**Jim Ray**, Secretary, 2520 S. Ivanhoe Pl., Denver, CO 80222

48 35th Reunion

Anita and **Verity Smith** continued the 35th Reunion "warm-up" cocktail party that Judy and **Graham Sterling** started in March 1982. In between, Rose and **Leon LaFreniere** and Joan and **Al Seville** had additional cocktail parties for classmates to discuss plans for the 35th Reunion next June. . . . Anita set out a croquet course on one of their 12 acres in Little Compton, R.I. It was a fabulous game (with women power almost overcoming the men) ending with Virginia Clifford and **Dave Finnegan** banging away at each other. A dense pad of grass caused Virginia's well hit ball to bounce over Dave's ball, saving him. Dave came back with a solid tap that drove his ball into Virginia's, making Dave the reigning champion of croquet in our class. Dave will be challenging all classmates at the reunion.

Don Noble, our reunion chairman, spoke about plans for the 35th Reunion. After sharing in Technology Day's events on M.I.T.'s campus, our class has reservation at the Chatham Bars Inn on Cape Cod for Saturday and Sunday. The first mailing to all classmates will provide date, location, and ask for a response indicating your plans to attend. The committee will arrange to have information about recreational opportunities in Boston and dormitory housing on the days before the planned group events. We are considering a class event on the day before Technology Day. This event might be a luncheon and tour of the Kennedy Library, which is situated overlooking Boston Harbor.

While Don was telling us about the reunion plans, Verity cooked a jillion hamburgers which were eaten by Barbara and **Mal Reed**, Olive and **Ken Stickney**, Virginia and **George Clifford**, Gloria and **Herb Lipson, Dave Finnegan**, Lois and **Bill Revoir**, and Judy and **Graham Sterling**. Anita made ginger and strawberry ice cream, which we all enjoyed.. . . Anita's mother and father both grew up in Little Compton, and their families have records of members back to 1692. . . . I wish everyone who reads this could have been at Verity's house with us.

Virginia and **George Clifford** were married on August 7, 1982. Their home is in Millis, Mass., and Virginia teaches in a resource room at the junior high school in Westboro. Virginia's daughter is a student at the New England Conservatory of Music. Her son is a sophomore in high school. George continues his international marketing and business development responsibilities with the Medical Division of Corning Glass in Medford, Mass. . . . **Bill Revoir** has joined Vaponics as manager of engineering. Bill's responsibilities begin with materials selection and end when the complete water purification system is assembled and shipped to the customer. Bill and **Verity Smith** met during World War II. Later they were thesis partners and still later lab associates while employed by M.I.T. Verity has built Vaponics from one to 55 employees, and his company enjoys the reputation for making the finest equipment to provide the highest purity water required by pharmaceutical and semiconductor manufacturers.

Howard Jacobson owns a company that makes hats—golf caps, tennis caps, yachting caps, visor caps, cowboy hats—in fact, they make 500 different styles. Some hats are constructed with fabrics, others with plastic, and the "straw hat" is molded in expanded polystrene. Many customers have messages printed on the caps. Howard moved the company to Scranton, Pa. from New York City many years ago. His son and son-in-law are key members of the company. Howard sells to customers in Japan, China, Korea, and other countries in the Orient. For each of the past ten years he and his wife Claire have made a five-week trip to the Orient. They find Japan very livable and very pretty. In addition to visiting Osaka and Kyoto they made a side trip to Mt. Fuji. Due to the frequent smog in Japan, they had never had a good look at Mt. Fuji, but the day of the bus trip the sky was glorious—blue and clear. The mountain, a volcanic cone standing alone on a flat plain, was huge and awe inspiring as they approached. To prevent jet lag Claire and Howard travel in stages, and they spend a few days in Hawaii while Howard plays some golf.

During our conversation I told Howard that at our 30th Reunion, we wore hats that his company had made. (**Don Noble** purchased them in Somerville the day before the reunion.) I suggested that Howard and Claire join us for the 35th next June.—**Marty Billett**, Secretary, 16 Greenwood Ave. Barrington, RI 02806, (401) 245-8963

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Sid Howell writes that he and Aileen are living in Perrysburg, Ohio. Sid is executive vice-president of the Dana Corp. Prior to 1977, he was president of Weathershead Co., and then joined Dana when a merger occured. Sid met another classmate while vacationing in Tucson, **George Haviland**, who with wife Betsy has retired to Arizona. After receiving his master's degree in 1950, George worked briefly at Grumman, then rejoined the Air Force. After a long career, he retired and joined North American as a structures project engineer for the B-1 bomber. When this program collapsed, George retired again and bought a business in Tucson. . . . **Walter Cremens** was recently promoted to principal structures and materials scientist for Lockheed Georgia Corp. He also was recently awarded the Wright Brothers Medal for the best aeronautical engineering paper presented to the SAE in 1980. . . . **William Haddon** is president of the Insurance Institute for Highway Safety.

Our class's beloved and grizzled past president **Stanley Margolin** led a large and distinguished audience last June when he spoke to over 200 industry and government officials at an Arthur D. Little executive forum. Stan stated that the United States faces a major shortage of materials and minerals because we are not planning for the technological future. . . . We regret to report the death of our classmate **Walter Norris McSweeney**. Walter had been president of the Normac Co. in Norwood, Mass.—**Paul E. Weamer**, Secretary, 331 Ridge Meadow Dr., Chesterfield, MO 63017

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Charles W. Dickinson reports that he has terminated work with Hess and Eisenhardt in Cincinnati, where he was involved with the building of armored cars. They have built hearses, ambulances, and special cars for our government and foreign governments and dignitaries. A recent job they had consisted of armoring the seven Chevrolet Impalas for the summit meeting of the presidents in Canada.

Charles' job is now with the chemical/plastics division of General Tire and Rubber Co. in Marion, Ind. They are building the fiberglass and epoxy cab for the Mack Truck Co. He reports that it is very interesting and has a promise for the future in that plastics are stronger and more durable than the current steels. . . . **John M. Hetherington** tells us that his previous firm of Fugard, Orth and Associates recently merged with Donohue and Associates to form a new corportion called Donohue, Hetherington and Associates, of which John is president. They will continue to serve clients with architectural and engineering services throughout the Midwest. Their offices are located at 534 W. Chestnut St., Hinsdale, IL 60521. The firm is now part of 78 largest A/E firms in the U.S.

In May Union Carbide Corp. announced the appointment of **John E. Anderson** to senior corporate fellow. Candidates for this position must demonstrate outstanding abilities in one or more technical areas of interest to the corporation and have received corporate, national, and worldwide recognition. Dr. Anderson has spent his entire career with Union Carbide's Linde Division. For his work on the Purox pyrolysis solid waste treatment system, he received the 1974 Merit Award for Personal Outstanding Achievement from *Chemical Engineering* magazine. His most recent work has been on the development of an oxygen combustion system that permits the use of pure oxygen in place of air to reduce the fuel consumption in high temperature furnaces. Dr. Anderson is the sole or co-inventor of 19 patents with three applications pending and has authored and co-authored numerous papers. He is a member of the American Institute of Chemical Engineering, the American Chemical Society, and the Combustion Institute. He resides in Katonah, N.Y., with his wife and has four children and four grandchildren. In 1977 Dr. Anderson spent a month at M.I.T. as a visiting lecturer to present a short course on heat transfer.

In July, **John F. McCarthy, Jr.** joined Northrop Corp.'s electro-mechanical division in Anaheim, Calif., as vice-president and general manager. Previous to this, Dr. McCarthy had been director of the National Aeronautics and Space Administration's (NASA) Lewis Research Center, Cleveland, Ohio. While there, he also served as a consultant to the Office of the Director of Defense Research and Engineering and as a member of the Joint Strategic Target Planning Staff, Scientific Advisory Group for the Joint Chiefs of Staff. He was also a member of the various NASA advisory groups. Prior to his NASA career, Dr. McCarthy was director of the Center for Space Research at M.I.T. where he was also a professor of aeronautics and astronautics. At M.I.T., he pioneered in space experimentation, data collection, and theoretical analysis. He also was chairman of the Advanced Systems Division Advisory Group of the Air Force Systems Command. He was honored by being selected to receive the Meritorious Civilian Service Award for his work on the Air Force's C-5A transport airplane and also received the Decoration for Exceptional Civilian Service for work as a member of the Air Force Scientific Advisory Board. Dr. McCarthy has written numerous technical papers and has contributed to four textbooks. He is a former director of the American Institute of Aeronautics and Astronautics, a fellow of the American Astronautical Society, associate fellow of the Royal Aeronautical Society, and a member of a number of other scientific and engineering organizations.—**John T. McKenna, Jr.**, Secretary, 1 Emerson Place, Apt. 11H, Boston, MA 02114

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"**John J. Magarian** is his name! He's in the Hall of Fame. . .," they used to sing in our section of D.11 back in 1948. The good-natured young man, a navy veteran, who was the object of this accolade graduated in Course XV and built his career in the semiconductor industry, working for several companies on the east and west coasts. For the last nine years he was employed by National Semiconductor in Santa Clara, Calif. A resident of Los Altos, Jack died August 21, 1982, while vacationing in Santa Cruz, Calif., apparently choking following an asthma attack. He is survived by his wife Shirley, three sons, three daughters, and his mother, a brother, and a sister. He was 53.

It is unpleasant to see a classmate's name in the obituary column of the evening paper, as I found the item above, but our names turn up in happier contexts, too. Last spring I received an invitation to a fund-raising barbecue for the benefit of a senatorial candidate. I did not go, although the event was only a few blocks from where I live, in the more expensive direction, but I noticed the name of **J. Burgess Jamieson** among the list of sponsors, hobnobbing in print with many of the leaders of industry in Silicon Valley. Burge earns his living these days as a capitalist in Menlo Park, Calif., raising venture capital for new businesses.

While some of us have so little influence we couldn't get arrested, I occasionally see that **Charles Schwartz**, professor of physics at the University of California, Berkeley, is using his influence to improve the nation. His latest good cause was the mass protest last summer against nuclear weapons research at the Lawrence Livermore Laboratory.—**Richard F. Lacey**, Secretary, 2340 Cowper St., Palo Alto, CA 94301

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Now for the news you've all been waiting for. **George Schwenk** was married to Catherine Priest Atkins on June 20. Congratulations to George and Cathy! Their address for personal best wishes is: Merriam Hill Rd., Mason, NH 03048.

While one of us was becoming a groom, another classmate joined the ranks of grandparents. **Athanasios Vulgaropulos** is the proud grandfather of Athena, who was born June 6. Alex is her proud father. Athanasios is also a new brother-in-law. He went to Greece last Easter to attend his brother's wedding. . . . **Dave Dennen** is traveling in the other direction. He is leaving Lilly Research Center, Ltd. in England, where he was managing director, to become executive director of Lilly Research Laboratories in Indianapolis, Ind. . . . Other Executive-type classmates include **Inaki Elguezabal**, president of Pyrotek (electrical and mechanical contractors); **Paul Stern**, vice-president of Coldwell Banker Commercial Brokerage Co., Los Angeles; and **Joseph Hurley**, who was recently appointed director of machine and manufacturing systems at Corning Glass Works.

We extend our heartfelt condolences to Caroline and **Russell Chihoski** on the death of their son Russell, who died in a rock climbing accident in Colorado. Russell was a member of the senior class at M.I.T. where he was majoring in electrical engineering and computer science. He is also survived by two brothers and three sisters.—**William Combs**, 120 West Newton St., Boston, MA 02118; **John Kiley**, 7 Kensington Rd., Woburn, MA 01801; **Louis Mahoney**, 52 Symor Dr., Convent Station, NJ 07961; **Dominick A. Sama**, 28 Chestnut Hill Rd., Groton, MA 01450

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As winter settles in and the freshmen start to take 8.01 seriously, it is time to speculate on why we hear so seldom from our classmates. To those of us for whom a blubber midsection is not a purchase at an Arctic meatmarket, a little warm note of reidentification to your class secretaries would be appreciated. And at the same time, you could heave a little gold into the Class Fund. After all, what good does it do to keep it? When you're gone, Uncle Sam will probably use it to subsidize capon breeders in Casper, or to finance condominiums for the emotionally carsick.

Not that I have anything against Casper or liberal causes, you understand. It's just that if I had life to live over, I'm not sure I'd be an engineer. I'd buy a purple Continental, a pair of fuzzy dice, and be a social worker. But I digress—back to the doings of our classmates:

Orlando Cuchiara has been promoted to president of Parametrics, Inc., in Waltham, Mass. Previously he was vice-president of the Process Instruments Division. . . . **Stanford Amstutz** is now at GTE Laboratories, which is also in Waltham. . . . **James R. Bartsch** has been appointed president of the recently formed Bard Laboratories, Inc., MSL Division, a subsidiary of Management Research Labs, Inc. Bard Laboratories is located in Amherst, N.H. . . . **Bill O'Neill** has a global range in his work. He is an engineer with the World Bank, currently working on projects in Egypt, Turkey, and Romania. . . . One of our classmates has a perspective to his work that is larger than global. **James A. Abrahamson** has been selected for three-star rank. Previously, Lieutenant General Abrahamson was a deputy at the Air Force Systems Command, but now he is associate administrator for Space Transportation Systems with NASA. He is often in the news these days on issues involving the space shuttle.

Air Products and Chemicals, Inc., of Allentown, Pa., has named **Anthony J. Diglio** corporate director of environmental activities. In this new position, he will be responsible for guiding Air Products' worldwide environmental activities to assure compliance with regulations. An Air Products employee since 1972, he was director of environmental activities for the Chemical Group prior to this appointment. He is a graduate of Harvard University's program in health and environmental management a member of the American Institute of Chemical Engineers, the Chemical Manufacturers Association's enviromental issues committee, and the Air Pollution Control Association. He is a registered engineer in Pennsylvania, New Jersey, and Texas.

In an article in the *Boston Globe*, **Roy Salzman** was featured as a guru of CAD/CAM. No, he does not sit on a mountaintop near Sikkim; Roy is president of Matra Datavision, Inc., an American subsidiary of a French electronics conglomerate. The

firm markets computer-aided design and manufacturing equipment. Roy left Arthur D. Little, where he has a 14-year career as a computer design consultant, to establish the sales, service, and technical operations of the new company in Burlington, Mass.

Marc Gross recently received a letter from **Denny Shapiro**, who is chairman of the board of Lifeline Systems, Inc. He reports his new company is growing nicely, with acceptance by over 400 hospitals in order to help elderly people at home to delay entry into nursing homes. Susan, who is a lawyer at Ropes and Gray, has taken up computer programming as well. Their children are as active as ever. Alison, 16, is in Israel for six months and will do a semester of high school there.

Send news items to your class co-secretaries.—**Allan C. Schell**, 19 Wedgemere Ave., Winchester, MA 01890 and **Marc S. Gross**, Winding Road Farm, Ardsley, NY 10502

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Over the summer I received two letters which I would like to share with the rest of the class. The first is from **Dick Teper**, Course XV-A: ". . . As this is my first report in 25 plus years, it's hard to know where to start. I think the report itself is prompted by the recognition that I have finally sold out to capitalistic establishment and have accepted an unexalted management position with Rocketdyne (Rockwell International). Since I am a Course XV graduate and theoretically trained in industrial management, it is not totally surprising I should end up managing in industry. It is a little surprising for me to find out how boring time cards, budgets, expense reports, personnel problems, and eight million non-productive meetings a day are relative to research and development.

"As you may recall, I left M.I.T. in January of 1956 with my education, suitcase, and a pint of brandy you bestowed upon me as a parting gift. By October of that year, I was a permanent propulsion flight test engineer at Cape Canaveral, trying to launch America's first satellite aboard the Vanguard while Werner Von Braun sat chomping at the bit with the Jupiter C. We got about two and one-half feet off the ground on live television—America's first space spectacular?—and my distinguished engineering career continued from there. In the spring of 1958, I came out here to California—the land of great weather, no morality, extravagant real estate, drug enhancement, ethical disenchantment, and relatively high salaries. Here I have practiced various forms of nefarious mechanical, electrical, chemical, and aeronautical alchemy in the aerospace business, culminating, I believe, in the development and demonstration of a pressure recovery system for a high energy chemical laser which is two to four times more efficient and smaller then anything previously concocted. We quickly discovered that there was no interest in, or application for, this device, and had in fact come up with the buggy-whip of 1977. With this achievement under my belt, I was obviously ready for promotion to management, and am now responsible for what I choose to call program integration for propulsion systems at Rocketdyne. This title has been chosen to maintain the anonymity of my responsibilities while I continue the pursuit of an education (and degree?) at Cal State Northbridge in operations research, and the development of my latest anachronism—a production program simulation model for the MX."

The second note is from **T. Guy Spencer, Jr.**, Course XV-B, who mused on the non-professional side of life: "After X number of years, something of significance has happened, so I take quill (Apple variety) in hand to communicate it to the class secretary.

"To those classmates of 'the most wanted class' who may have found, or be about to find, themselves less than wanted on the domestic scene, I am now prepared to answer that whispered query, 'Is there life after divorce?' Two years ago, I was married to Ann Murray, a native Floridian who had come north to help with the task of educating the savages of Massachusetts. Three days ago (August 20) we were presented with our own 6-pound, 7-ounce junior savage—James Robert by name.

"For those classmates who haven't done any new parenting for a while, I can report that things are much changed. Fathers are no longer treated as germ-bearing necessities, banned to the outer reaches, but can, with a short course of instruction, enter the hallowed sanctums of the delivery room, to participate in the joyous occasion. At today's prices, it had better be joyous! Tonight, Ann and I celebrated (rhymes with celibate) our second wedding anniversary by sharing a hospital-cooked stuffed lobster dinner, consumed in the romantic atmosphere of the O.B. ward, ignoring the wailing cries from the nursery and the indescribable distractions of semi-mobile patients attached by tubes to their I.V.s. We agreed that it was one of the nicest anniversaries we ever had.

So, the answer to the question posed above is a resounding 'maybe'. Actually, it's 'yes', if we are willing to throw away a lot of pictures about what life is supposed to look like. Life doesn't always live up to our pictures, but it can still be great! For those who may be curious, Ann and I met when she got interested in learning to fly gliders and joined the M.I.T. Soaring Association where I was an instructor. She has subsequently earned her pilot rating and was flying solo as late as one month prior to the birth of James. We hope he likes to fly."—Co-secretaries: **Robert Kaiser**, 12 Glengarry, Winchester, MA 01890, (617) 729-4345; **Caroline Disario Chihoski**, 2116 W. Davies Ave., Littleton, CO 80120, (303) 794-5818

58 25th Reunion

Here we are in our 25th Reunion year. Seems like it was just yesterday, doesn't it? From the mail we are receiving, though, it looks as if everyone is looking forward to the big event this June. Although this column is written while lazing on the beach in August, your reunion committee has been working for many months by the time you read this in December. More reunion news later, but now is the time to plan for the big event.

Among those planning to attend the reunion are Karen and **Bob Schmidt**, who wrote to say, "Looking forward to seeing all our friends next year—see you there!" . . . From the west coast, **Ray Hybarger** reports that he is now manager of biochemical engineering for Fermentec Corp., a firm providing systems to manufacture products from food wastes by fermentation processes. . . . **Jim French** just passed his 15th anniversary at the Jet Propulsion Lab, where he is manager of advanced planetary studies. He is also serving as chairman of the Los Angeles section of the American Institute of Aeornautics and Astronautics. In his spare time, Jim is a search pilot with the Civil Air Patrol and also participates in privately funded space activities. . . . At Pan American World Airways, **Roden Brandt** has been named senior vice-president of airline planning, responsible for scheduling, marketing, and economic analysis. Previously, he served as vice-president of the Western Division in Los Angeles. . . . Mary Jo and **Charles King** are in their fourth year in Midland, Tex., where he is region exploration manager for Union Oil of California. Their daughter Jennifer is now a sophomore at the University of Texas, while Tracy and Chris are in high school.

John Niland has become assistant superintendent at Bethlehem Steel's Burns Harbor plant. John has been with Bethlehem since graduation, initially at the Sparrows Point plant. John, Joy, and their children live in Valparaiso. . . . **Chris Gimre**, currently a vice-president of the Owens Illinois Plastic Products Division, has been appointed general manager of basic bottle operations for the division. In this post, he will be responsible for marketing and profitability of the high-density polyethylene bottle business. . . . **Elizabeth Drake** sent us a note saying, "I'll be leaving my position at A.D. Little for an exciting second career as chairman of the Chemical Engineering Department and Cabot Professor at Northeastern University. I'd welcome advice from all my colleagues and classmates who have an interest in the possibilities of cooperative education and applied research in a university environment." . . . **Dan Schneider** has established Information Resources Management Associates, Inc. in Washington, D.C. The firm engages in management, technical training, and consulting in the organization-wide management of data and information.

Ken Langley has been promoted to full professor of physics at the University of Massachusetts in Amherst. Ken's daughter Christine just entered the University of Vermont this fall. . . . Out on Nantucket, **Carl Borchert** is active in working to preserve the natural resources and rural and historical character of that unique island. . . . **Stephen Corman** has returned to IBM's Washington Systems Center after a two-year stint with the firm's Advanced Education Center in Chicago. Most of his present activities are in software support in the storage products area.

Inspired by the election year, let us encourage you all to "write once, write often" in this, our fifth quinquennial year. Happy holidays and best wishes for the new year.—**Michael E. Brose**, Secretary, 59 Rutland Square, Boston, MA 02118

63 20th Reunion

Greetings and salutations. I see that our class notes column now bears the masthead, **20th Reunion Class**, so I'll begin with reunion news. The reunion dates are Friday through Sunday June 10-12, 1983. Preliminary plans call for the events to be held at the Wychemere Harbor Club in Harwichport on Cape Cod. There will be a cocktail party Friday evening, beach and picnic activities Saturday afternoon, and a banquet on Saturday evening. A Sunday brunch will conclude the festivities. Anyone with ideas for the reunion or classmates who wish to help with the organization of our get together should contact class president **Ira Blumenthal** at American BHF Corp., 21 Cummings Park, Woburn, MA 01801. I know it sounds far off, but mark your calendars now and plan to attend.

Harwichport offers the combination of accessibility to Boston with the pleasures of the Cape. You can drive or fly in, spend a pleasant weekend, and be back home Sunday night. . . . Or, make your visit to New England part of a longer vacation. Let's make this our best turnout. Those of you who haven't attended a reunion might enjoy spending a few days with old friends. Those of you who have attended before, why not convince a classmate who hasn't come to join us? We look forward to seeing you.

We had a most enjoyable visit in July from **Jack Solomon**. Jack was in southern California on business and came by for dinner. He is living in Rye, N.Y. with spouse Jan and daughters, Susan Ruth, 5, and Lisa, 8. Daughter Sheri is 23 and married, and living in Santa Barbara. Jan teaches high school chemistry, physics, and math in Rye, and last year she took a sabbatical leave to brush up on her calculus and physics. Jack is at Union Carbide, where he is process manager for marketing and new process development of industrial gases. The focus in his activities is on the electronics and metals industry uses of these gases. Jack's career has included work in technical, administrative, and marketing areas, and he says that after working 12 years for a large company he has even given thought to working in a small company or entrepreneurial situation. Small company presidents take note—if you need a jack-of-all-trades, there may be one available here.

George Staradub reports that he is still working at Sanders Associates in Nashua, N.H. for Darold Rorabacher, '62. Greg acts as advisor to an Explorer Scout post whose main interest is computers and programming. He also volunteers in the Nashua School System, teaching programming to elementary school students. . . . **Malcom Beaverstock** is in his eighth year with the Foxboro Co. He has just made a shift from the technical to the business side of the company, taking over as manager of Foxboro's systems product line managers group.. . . **John McNally** also writes about starting a new career without leaving his company. After 15 years in research and development and two years in corporate marketing at Koppers, John has started as manager of facilities and support for science and technology. This position includes responsibility for personnel,

craft services, finance and accounting, computer services, and safety.

Paul Shapiro was re-elected as president of the M.I.T. Luncheon Club of Washington, D.C. Paul is a consultant to the Office of Toxic Substances of the U.S. Environmental Protection Agency. . . . **Phil Marcus** was married last April to Linda Marsden. Linda who holds an M.S. from Johns Hopkins, is a professional in the field of training and development. Phil's son Gary (from a prior marriage) is 12 and is interested in the stock market. Phil says that as a socialist he finds this a bit painful. To ease the pain, Phil practices equal employment opportunity law as associate general counsel of the Maryland State Commission on Human Relations. . . . **Stephen Evans** informs us that he is still at the Rocketdyne division of Rockwell International in Canoga Park, Calif. After two years as program manager for high energy laser technology, Steve spent six months as acting director of advanced laser programs. He is currently director of marketing and new business development for propulsion systems. Last May Steve attended Merger Week at the Kellogg Business School of Northwestern University. Steve also reports having lunch in Woodland Hills, Calif. with **Ed Kanegsgerg**, who is with Litton Industries. Although it may be hard to believe that we have college age children, Steve says that his oldest, Jane-Marie, will be starting Humboldt State University in September.

A few press releases inform us about our classmates' promotions, including . . . **Ted Bednarski**, named director of research and development for Hercules, Inc. Ted has been with Hercules since 1967 in management positions in research and technology. Prior to his new assignment, Ted was director of technology and marketing. He is also a member of the board of directors of Adria Laboratories Inc. of Columbus, Ohio. . . . **John Poruk** was named mechanical department head by Mountain States Engineers of Tucson, Ariz. John has been with Mountain States since 1977. . . . **Steve Kaufman** has been appointed president of the Electronics Distribution Division of Arrow Electronics, Inc., the world's second largest distributor of electronic components and computer products. For the past two years Steve was with Midland Ross Corp., most recently as group vice-president. Prior to that, he was a partner in the management consulting firm of McKinsey and Co.

I'll close with a personal note. My older daughter Amy, now 17, is a high school senior. Back in July she and Barbara made the "college tour" visiting several Ivy League schools and . . . M.I.T.! Is this possible? Why, only yesterday I was graduating myself—how can I have a college age daughter? But it must be so—Barbara took some pictures of Amy standing in the Great Court (Killian Court), and stamping through my old stamping grounds in Baker House. It's a very strange feeling.—**Mike Bertin**, Secretary, 18022 Gillman St., Irvine, CA 92715

62

The news for this issue is fairly brief. Once again I invite class members to send me a short note describing what you are currently doing. . . . **George Krebs** attended our reunion last June and is currently section manager at Computer Sciences Corp. in Silver Springs, Md., supporting NASA's Goddard Space Flight Center. . . . Pam and **Glenn Buckles** have returned to Washington D.C. after a five-year Air Force tour in Germany. He is now at the Air Force Systems Command Headquarters, doing policy and planning for management information systems.

George (Bud) Hippisley joined Moog, Inc., East Aurora, N.Y. in the spring of 1981 as general manager of the Electronics and Systems Division. He is still active in amateur radio with the call K2KIR. . . . **Wesley Wolf** lives in Houston and has a son and daughter soon to be teenagers. He works for Union Carbide, selling proprietary chemical and refining technology and hardware. . . . Finally, I have the sad duty to report the death of **Leslie Tharp** of Cobleskill, N.Y., who graduated in mathematics and received his doctorate in 1965.—**John Prussing**, Secretary, 2106 Grange Dr., Urbana, IL 61801

65

You've heard of compact cars? This is a compact column. . . . After 12 years in Los Alamos, N.M., **Jim Breedlove** has joined Conoco in Ponca City, Okla. He will continue his work in image processing but now in the quest for oil. . . . **Durk Pearson** is a co-author of a new book, *Life Extension*, that reveals the "ever expanding technology that can enable anyone to enjoy more of the pleasure and strength of youth." Durk has been a consultant and his work on life extension has gotten him popular guest appearances on the Merv Griffin show.

Jeff Meldman, now in the office of the Dean of Student Affairs as well as the Sloan School, had an article in the *Sloan Management Review* on ethical responsibility in management information systems. . . . **Ed Burke** has left the MITRE Corp. after 11 years to join Data General as manager of their North Carolina research operation. Anyone who read the *Soul of a New Machine* is probably familiar with DG's activities in North Carolina.

So much for November/December. Send a note to your secretary for Christmas, and I'll print it next spring.—**Steve Lipner**, Secretary, 6 Midland Rd., Wellesley, MA 02181

66

There was no difficulty in getting into the spirit of writing a November/December column in mid-August, since the weather here approximated late fall.

Stephen Webster, practices law in Randolph, Vt. and is running for state representative in the Vermont Legislature. Good Luck! . . . **Thomas Bush** is in a much warmer climate—Titusville, Fla., where he is director of Engineering for Fairchild. . . . **Mark Yogman** is director of administrative planning for Mobay in Union, N.J.. . . **George Bourrie** received his M.S. in computer science from Villanova University.

Best note of the month came from **Robert Curd**. He has just been promoted at Hughes Helicopters to program plan manager, but the big news is that he has issued a challenge through our column. Bob ran 10 kilometers in 40 minutes, 35 seconds, and doesn't think **Wayne Baxter** can beat that! . . . Our class president, **Stu Vidockler**, has written to me again wanting to know when we are going to get some regular sources of news. By this he means people who write directly to me with news about themselves and their friends in our class. Well, what am I supposed to tell him? Let's do it!—**Joe Shaffery**, Secretary, 34 Hastings Dr., Fort Salonga, NY 11768

67

All of the seven women in our class who attended the 15th Reunion last June have active business careers, although a few took time off to raise families. Information on these very busy women follows. **Carolyn Voss Iuzzolina** and her husband **Harold Iuzzolina**, (who started with the Class of '64 but had the good judgment to marry Carolyn and finish with our class) have spent most of their time since graduation in New Mexico. Carolyn worked as a systems analyst at Sandia Labs for four years from 1969 to 1973, took seven years off to have more time with their children, Terri, 11, and Mark, 7, and reentered the work force (the **paid** work force, that is) about two years ago to become a stockbroker and financial planner for Universal Heritage Investment Corp. in Albuquerque, N.M. Both Carolyn and Harold have master's degrees in math from the University of New Mexico. Harold was on active duty in the Air Force in Albuquerque for four years until 1973 and has since then been with the New Mexico Engineering Research Institute at the University of New Mexico. He is a senior research scientist.. . . Dr. **Nancy Levine Hall** has been with the American Health Foundation in New York City for more than a year. She is an epidemiologist specializing in occupational exposures. . . . Dr. **Margaret Skiles** is a plastic surgeon in Worcester, Mass. and is also affiliated with the University of Massachusetts Medical Hospital.

After graduation from Rutgers Law School in 1975, **Kathy Frazer White** lived with her family in California for six years, where she worked as an attorney for Dart Industries and American Medical International. They now live in Chatham, N.J., and she is an attorney with Sealed Air Corp. She and **Ben (White)** both attended graduate school at the University of Arizona following their graduation from M.I.T., and she subsequently worked at Raytheon before going to law school. Ben worked at Caltech and the Jet Propulsion Laboratory in California, and is now doing research for Exxon in New Jersey. They have two sons, Adam, 13, Ethan, 7, Ethan having been born during Nancy's last year at law school. . . . **Mike** and **Linda Mammon Tashker** are happily settled in Palo Alto, Calif. Linda is with NEC Electronic Arrays in Mountain View, and Mike works at the Stanford Research Institute. Linda was surprised to see how big the trees at McCormick Hall had grown. Their two children are now 6 (Jessica) and 4 (Sara). . . . **Marsha Seiden Starkeson** lives in East Derry, N.H. with her 9-year-old daughter, Ellen. She is a programmer and software engineer with DEC in Merrimack, having previously worked with Hendrix Electronics, Inc. in Manchester. Her former husband, **Gerry Starkeson**, lives in Nashua, N.H. . . . **Elaine Ackles Chandler**, who teaches math at the University of Illinois, returned to M.I.T. last year for one year to teach math. She has a Ph.D. in physics from the University of Illinois. She and David, '66, have two daughters, ages 13 and 16.

David Sanders has been named director of corporate development at Hewlett-Packard in California. He is responsible for planning, mergers, and acquisitions. . . . After 12 years of marriage, Nancy and **Tom Compton** proudly announce the birth of their first child, Kimberly Dawn, born September 5, 1981. Tom is consulting in application software in the Newport, R.I. area. . . . **Ted Williams** received his glider pilot's license last year and does most of his soaring around Warrenton, Va. Ted and Karen recently enjoyed a vacation in Switzerland. . . . **R. A. H. Buxton** has moved to Toronto to become manager of the Instrumentation Division of Moniteq, Ltd. . . . **Paul Tarantino** is back in the flying business with the U.S. Navy Patrol Squadron Forty at Moffett Field, Calif., where he flies as a tactical coordinator in P-3C Orion anti-submarine patrol aircraft. Paul returned in June from a deployment in Japan, Korea, Guam, and the Philippines. . . . **Eileen Cella** is now a full-time graduate student at the University of North Carolina at Greensboro in pursuit of a Ph.D. in family relations and child development, which she hopes to complete by May 1983. She has an avid interest in wellness, nutrition, and fitness, and has worked as the statistician for the Center for Creative Leadership in Greensboro for the past three years. She is the single parent of two boys, Patrick, 9, and Richard, 7.

Alan Hausrath, a mathematics professor at Boise State University, has been awarded a grant of almost $10,000 to lead a team of three other mathematicians who will lecture and teach short courses in their specialties in Colombia, South America. Alan previously taught at the University of the Andes in Merida, Venezuela. . . . **Steve Metz** writes that he and his wife Sandra have both reached milestones in their lives. As of last June, Steve had managed to survive a four-year residency in obstetrics, and Sandra had just been admitted to the Maryland bar. Their future is somewhat uncertain, however, since the Navy, which financed his medical education, would like payment in kind, the next two years of which will be on Guam. Steve and Sandra have three children. . . . **Don Davis**, associate professor of mathematics at Lehigh University, has a leave of absence to work with experts in the field of topology at the University of Warwick, England, during the 1982 fall semester. He also received an invitation from the Institute of Advanced Study in Princeton, N.J. for the 1983 spring semester to further his research interests. Prior to joining Lehigh, Don received a Ph.D. from Stanford and was on the faculties of Northwestern University and the University of California at San Diego. . . . **Steve Douglass** serves in the dual capacities of vice-president for administration and assistant director for U.S. Ministries for the Campus Crusade for Christ International, an interdenomina-

tional ministry with approximately 16,000 full-time and associate staff serving in 151 countries and protectorates. Steve joined Campus Crusade in 1969 after graduation from Harvard Business School. He has written two books, *Managing Yourself* and *Managing Yourself Leader's Guide*, and is a frequent speaker on management and other topics. He and Judy have two daughters and are active in the First Baptist Church, Yucaipa, Calif., where Steve teaches a Sunday school class.—**Jim Swanson**, Secretary, 878 Hoffman Terrace, Los Altos, CA 94022

68 15th Reunion

Class Hero-of-the-Month goes to **Mike Rosenblum**, who reports on several classmates as well as friends from neighboring classes. He writes that a few months ago he had a mini-reunion in Washington, D.C. with **Jay Hellman, Mark Zibelman**, and two others from the Class of '69. He says, "All are looking and doing just great." Jay is halfway through building an entire square block in downtown D.C. Mike and his wife Kiki are waiting out the garment center slump, but otherwise doing okay. . . . **Steve Ostrach** writes that he and his wife, Linda Eisenmann, are the lucky and proud parents of a wonderful son, Daniel Eisenmann Ostrach, born August 1981. Steve continues to work for the Massachusetts Attorney General handling general civil litigation, particularly administrative and tax law. He was recently promoted to chief of the Affirmative Litigation Division and looks forward to suing the bad guys instead of being sued by them. . . . **Armen Varteressian** is still managing software publications for Digital, and, when he wrote, was "enjoying the warm weather after what seemed like a hundred years of cold and snow." (Now you get a notion of the time lag that exists between your writing to M.I.T. and publication.) Armen reports that his family has finally reached critical mass—one daddy, one mommy (Laura), one big sister (Roxanne, 3), and one little brother (Adam, 5 months). "At the rate he's going," says Armen, "Adam will be the largest member of the family sometime within the next two weeks." So I guess it must have happened already.

Steven Gamer reports that he and his wife became the parents of a daughter, Alysa, in February 1982. They expected to travel south to Washington, D.C. this past August with sons Adam and Mark and daughter Alysa. . . . **Andrew (Friedland) Schiff** took a leave of absence from his law firm to travel throughout South America for eight months in 1980. He married Deborah Cohen, an investment banker with Mueller and Co., in November 1981, and has now formed a new law firm—Sanders, Sierchio, and Schiff—in New York, specializing in corporate, tax, and real estate transactions. . . . **Ken Theriault** writes that he is still living in Lexington, Mass. and still working at Bolt, Beranek, and Newman. The house that seemed big enough for them a few years ago is now bulging with Marcie, himself, and three active kids—Seth, 7, Emily, 5, and Leah 2. . . . **John Clearey** and his wife Nancy now live in Needham, Mass. with their two children, Nina, 10, and Eric, 8. He is a partner in the Boston law firm of Goodwin, Proctor, and Hoar, specializing in employee benefits, compensation, and related matters.

Thomas Penn reports that he graduated from the University of Pennsylvania School of Law in May 1982. He is currently part of a group forming a venture capital firm in Philadelphia and is doing strategic planning consulting as well.. . . Lynda and **Harvey Newman** sent us a birth announcement for their third child, Matthew David, born January 1982. . . . We see from a recent publication of **Gary Bjorklund**'s that he is currently manager of the quantum electronics group in the Exploratory Optics Department of the IBM Research Laboratory in San Jose, Calif. . . . **Paul Forbes** reports that he is working for Bechtel Power Corp. at the San Onofre Nuclear Generating Station (fondly known as SONGS) near San Clemente, Calif. He writes that he is a California homeowner, beach lover, and Jupiter-effect survivor. He is also enjoying his new son (number three), now 9 months old. . . . Finally, **Stephen Passage** writes succinctly, "Need a break from New York City. Going to Alaska canoe-camping for four-six weeks this summer."—**Michael Marcus**, Secretary, 8026 Cypress Grove Ln., Cabin John, MD 20731

69

Well, not too much this month. I got a note from **Eben T. Walker** who is now working for a computer service company which specializes in advertising agencies, but he didn't say who or where. . . . **Stan Zdonik** expects to get his Ph.D. in computer science from M.I.T. in January. I often bump into him at the Alumni Pool, where he is much more regular in his swimming schedule than I. . . . **Rho Chao**'s wife Ping is expecting twins at the end of the year. They're starting into parenthood in a big way! If you're in the L.A. area and need a good dentist, look up Rho's dental clinic in Norwalk. I get all my dental work done there.

In January **Tom Najarian** will be leaving the V.A. to begin private practice, working out of an office in the solar home he designed in Belmont. Clearly, self-employment seems to be the trend. . . . I've just gotten back from the World Science Fiction Convention in Chicago and am now trying to get out three more books in time for the World Fantasy Convention in New Haven at the end of October. The Stephen King book has sold out, except for what we're holding for direct mail orders, and things are looking reasonably good. Between the two companies I'm hoping for seven more books by the end of the year. . . . Remember, if I don't receive any news, I can't pass any on. Have a good Christmas.—**Robert K. Weiner**, Box 27, M.I.T. Branch, Cambridge MA

71

Typing the class notes gives me the privilege of putting something personal in first: Lucy and I are proud to announce the birth of Lydia Anne, born July 23, 1982. . . . **Michael Chrzanowski** returns to California as coordinator, Marine/Intelligence, Chevron Shipping Co., after five years in New Jersey. He and his wife have two children: Mary Ellen, 3, and Peter Michael, born May 10. Michael also admits to owning a station wagon and a dog and living in the suburbs. . . . Dr. **Michael A. Pustejovsky** is on the faculty in the Department of Aerospace and Mechanical Engineering at Boston University.

Vincent J. Mannoia published a book—*What is Science*, a text on the philosphy of science. He is teaching logic with a computer and still wondering if **Joel Fox** married before 1977 (they had a bet). . . . **R. Scott Stricoff** recently presented a paper before the American Chemical Society on the construction of safer toxicity testing laboratory facilities. . . . **Mike Gilmore** writes that he is marrying Ronda Miller of Boise, Idaho this year. He is looking forward to more visitors like Paul Johnston, '70, who came through Idaho on his way to Alaska.—**Hal Moorman**, P.O. Box 1808, Brenham, TX 77833

72

Gail Thurmond has moved back to the Boston area and set up an internal medicine and neurology practice with the Blackwell Medical Associates in Brookline. She took a great trip to Paris and Brussels before starting. . . . **Lee Brown** has been an attending physician at Mt. Sinai Hospital and has been doing research on respiratory control. Also he and Carol were expecting their first child in June. . . . **Jeffrey Kaufman** decided to "go into the real world as a vascular surgeon." . . . **Eve Sprunt**'s second child, Elsa Dunbar Sprunt, was born July 26, 1981, with the same birth height and weight as her brother and the same birth weight as her dad, **Hugh Sprunt**. Hugh's been a great dad while Eve's been away on business trips. . . . Jan and **Chuck Ward** report: "We are alive (?) and well (?) and living with a 3-year old (!)—our son Brendan. Our schooling never prepared us for parenthood!" . . . **Jeffrey Chasin** married Dorothy Derifield in November 1980. . . . Last year **William Robert** loved every minute of the Great Fourth of July 3rd East Reunion. He's since been selected for promotion to lieutenant commander, U.S. Navy.

Robert Clark has finally given in to being a master's candidate in computer science at the University of Colorado. "This rash attempt to recapture a misspent youth may lead me back to M.I.T. someday, because it's going so well so far." . . . **James Davis** had a pleasant but hectic two-and-one-half weeks in Japan in order to assess what's available (and future trends) in their display technology. . . . **Thomas Klinkner** graduated from the law school at the University of California at Davis in 1975, where he practiced law for five years, becoming one of the founding partners in a firm serving rural Alaska municipalities and school districts. Then back to Stanford to get an M.B.A.

Howard Klein has set up a patent law practice in Newport Beach, Calif. He, his wife Janet, and daughter Jenessa live in Irvine, Calif. . . . **Robert Ellis** is a lawyer specializing in real estate and taxes with the Lorain, Ohio firm of Wickens, Herzer, and Panza. When he started with them in 1975, it was a four-man firm. It has since tripled in size. In August 1981 his wife Flossie had son Robert York Ellis who joins 3-year-old daughter Tara. . . . **Steven Tavan** opened his first one-man show of photographics at the M.I.T. Museum in November 1981 through January 1982. It was a smashing success by all accounts. In his other time, he works at Draper Labs on a computer system for a nuclear power plant.. . . **Rafael L. Bras** won the 1981 American Geophysical Union Horton Award. . . . **Richard Arratia** began teaching in the mathematics department at the University of Southern California in September 1981. He's still writing about coalescing and annihilating random walks and other interacting particle systems, and has been trying to swim daily in the "too cold ocean."

Adnan Akant married Alison Heiserman, Wellesley, '77, in Washington D.C. on August 29, 1981. Adnan continues to work for the World Bank in the Treasurer's Department, trying to out guess world financial markets in raising and investing the bank's capital. Alison is a lawyer at a D.C. law firm specializing in government contracts and international law. . . . **Richard Braun** is a contracts administrator for UOP, Inc. Corporate Research Center. He and Eileen have two daughters, Stephanie Lynn, 4, and Lauren Sue, 1. . . . **Thomas Diprete** continues to teach and do research in sociology as an assistant professor at the University of Chicago. He got married in the summer of '71 to Katherine Ewing, an anthropologist and a candidate at Chicago's Institute for Psychoanalysis. "Life goes on." . . . After his clerkship with Hon. Eugene, and Nardelli, **Robert Grimble** has taken on his own law practice in Manhattan. Things started lean, but, with such a talented person in charge, promise to flourish. Robert's amazed at how hard he's been working, but it's been worth it. . . . I regret to note that **John G. Gashnig** has passed away. He had been living in Mountain View, Calif. . . . **Daniel Charles Margulis** is the product manager for Crocker National Bank's professional services section for all of California.

Keep those notes (and donations) coming. Life continues to be hectic in the financial markets with another record-breaking day and week, a far cry from my old law practice or the tranquility of Egypt and Ethiopia between jobs.—**Wendy Elaine Erb**, Co-secretary, 531 Main St. Apt. 714, New York, NY 10044

73 10th Reunion

Hello from the sultry South..There's a paucity of news this month, so everybody gets the full treatment. Dr. **William Stern** is opening a practice in gastroenterology in Rockville, Md. William's little boy is now 2 years old. . . . **Alan Lehotsky** is shooting for a record, having been working on the same project for six of the seven years he's been at DEC. At the M.I.T. telethon, he spoke with several old Burton thirders, including **Gerry ("Flah") Fly** and **Joe Gorin**. . . . **Tom Fenstermacher** is now consulting with Pickard, Lowe, and Garrick in Washington. Among the projects he plans to be involved with is the probabalistic risk analysis for Seabrook. He and Carol should have found a house by printing time.

I realize this has not been up to my usual light-

hearted standards, but if you don't write, I can't improvise! Ruth and I attended Pink Cadillac City, i.e., the 20th Mary Kay seminar in Dallas in August, where yours "keglerily" (after drinking a keg?—*ed.*) won the mens' team bowling tournament. If the old Phi Delt team could see me now!—**Robert M.O. Sutton, Sr.**, Secretary, 819 Buckingham Ct., Warrenton, VA 22186

74

After all these years, my biological stress clock is telling me (at this writing—September) that it is time to start going to classes again if I am to get through the fall semester. However, by now many of us no longer have to worry about final exams. The Thanksgiving and year-end holy-days have taken their place.

Many of you (about ten) have begun to send letters. Either it is part of the maturation process, or it the seduction of seeing your name in print that is driving you to communicate. Keep up the mail (I get ten cents for every one of you that I sell to the junk mail people!).

On the political front (is there a rear?), a new class agent (hit man for the Alumni Association) has appeared. **David Shiang** will be the focal point for our class efforts towards fund raising. **E. Martin Davidoff** deserves our thanks for carrying the banner up to now on a very tough battlefield. He has earned a rest so that he can get to know his wife and children again. There will be more news about David and his plans in the months to come.

Now for the news. **Gene Zaglin** (a new pen pal) has completed four "expensive" years at Georgetown University Medical School. He is now engaged in a combined residency in emergency medicine and internal medicine at Northwestern University. He says Chicago is okay, but he misses Boston and is looking forward to our 10th Reunion. . . . **Paul E. Schindler, Jr.** writes that he has become executive vice-president of Keep/Track Corp., which is an office automation consulting firm in Corte Madera, Calif. He and his wife, Victoria Marlow, and their daughter, Marlow Lynne, are living (in his words) in the land of fruits and nuts which encompasses the San Francisco suburb of Orinda. . . . After five years of practicing law, **Michael Moureau** is heading into a medical career. He is a first-year medical student at Georgetown (see above regarding cost). His former ATO roomate, Bob Sherrick, '75, is entering his second year at the same expensive institution. (Note: Our classmates apparently have plenty of money to throw around. Please send in ideas on how they might spend it. Thank you.—*JG*).

Lee and **Walter Frank** are happy to announce the birth of their daughter, Caroline Elizabeth, on July 2, 1982. I had the pleasure of seeing the young lady at the beach during the annual Project Software and Development, Inc. picnic in August. She was quite articulate but declined comment as to her impressions of the world around her. . . . Back in July, I was just about to step out onto the ice for a weekly hockey game when **Michael Perlmutter** announced that he and his wife Yvonne had a new daughter, Ruth Margaret, who had arrived in April. That makes two daughters. Mike's ability to score is unquestionable. . . . **Jeffrey T. Mayne** flew in from the Coast during the summer for a week's reunion with the old MacGregor Turkeys (of which he is a founder). He is at Caltech doing basic research on bird-whistle production. . . . **Henry A. Magno, Jr.** is in his second year of study for an M.B.A. from Boston University. His idle time is still spent on searching for vintage Mercedes automobile parts around the country. He remarks occasionally on the scenery in the Commonwealth Avenue area. He is not talking about cars.

Since the world is always changing (and the business climate even more so), I have left Index Systems and can now be found at Metcalf and Eddy in the Government Center area. I have taken on the position of manager of systems programming and operations. So it goes. In the background, I masquerade as a consultant under the name of Gateway Software. Everybody does it these days. . . . Final thoughts: This is an election year. Voter turnout is down and things are getting worse. You don't have to be a statistician to figure it out. . . . Also, please send me software for my IBM Personal Computer. I will send you a thank you note and return your magnetic or other media. . . . The next column will also start talking about our 10th Reunion. Start preparing for the emotional shock.—Co-secretaries: **Jim Gokhale**, 12 Pond Ln., No. 54, Arlington, MA 02174; **Lionel Goulet**, 34 Tremlett Sq., Dorchester, MA

75

Two items from **Charles Fendrock**, the class treasurer and vice-president: "After working for almost seven years at Hewlett Packard Medical Products Division in Waltham, Mass. as a design engineer and production engineering manager, I left to join Symbolics, Inc. in Cambridge as manager of research and development operations. They make single user, development station Lisp processors that are very quick. Symbolics is quite an exciting place to work." And on a more important note: "After wining and dining ourselves two years ago at the 5th Reunion, the Class if '75 is illiquid—that's right, we're bankrupt, you know, $28 in the bank and we owe M.I.T. $400. If everyone who attended would sacrifice yoo-hoo and ice cream for just one week and send $5 or $10 to Alex, our secretary (checks made payable to M.I.T. Class of '75), we could clear our debt with the Institute and make way to really get waylaid in 1985. Don't be bashful, now!"

Lawrence H. Summers was named associate professor of economics at M.I.T. last February. In the spring he was appointed to a chair endowed by the Class of 1922 to recognize professors who are outstanding in teaching as well as in research. According to a press release by the Department of Economics: "One of his major contributions has been in his analyses, with Kim Clark of Harvard, of the structure and cyclical behavior of unemployment, revising a view, which gained ascendancy in the 1970s, that the bulk of unemployment was short term. His continuing interest is in the examination of the determinants of saving and investment decisions and the impact of various forms of taxation on total savings and investment." He has had over 20 articles published in journals. Last summer, after President Reagan named Martin Feldstein to be head of the Council of Economic Advisors, Larry was asked to come down to Washington to help the CEA.

Also in Washington, **James Moody** reports that he has left Hogan and Hartson to wield a "cutting edge sword" at the Capital Legal Foundation, a non-profit public interest law firm concerned with the federal regulation of economic activity and generally advocating a free market approach to such regulation. Alumni visiting D.C. are invited to call ahead for a place to stay (their couch) or to get together for dinner.

Charles Digate is presently managing the startup of an 1,100-person demonstration network for TI's home computer business and just completed a one-year stint as manager of TI's Consumer Products Market Research Department. . . . **James Ting** received his M.B.A. from the University of Chicago in June 1981. He is now working for Intel and living in Palo Alto. . . . **Barry Weinstein** is working for Citibank in New York and, at last report, had almost finished his M.B.A. . . . **Steven Wilson** resigned from Arabian American Oil Co. at the end of 1981. He and his wife Beth left Dhahran, Saudi Arabia and moved back to the States. Steven has joined Superior Oil in Houston, Tex. . . . **William DuPont** is an assistant professor of chemistry at the State University of New York at Binghamton. . . . **David Strauss** says, "Our No. 2 son Benjamin was born February 19. I am still living in Needham and enjoy bicycling to work at Teradyne in Boston, where I am a product engineer in charge of backplane and bare-board testers. I'd like to hear from other former denizens of Runkle 4!"

Kenneth Rumstay is an instructor at the Department of Astronomy, Ohio State University. He also works on a part-time basis as a consultant to the Ohio Board of Regents.. . . **Bruce Fegley, Jr.** has been a lecturer on astronomy at the Harvard College Observatory, where he has been involved in the development of a new model for the solar nebula. He says, "This work should lead to a better understanding of the origin of the planets and meteorites. This summer (past) I am moving back to M.I.T. where I am joining the ceramics division of Course III. I will be studying the chemistry of the same types of materials but with a decidedly more practical application!"

Joel Kulp has relocated from the Chicago, Ill. to the Fort Worth, Tex. facility of Motorola Communications Division. . . . **Ross Shachter** received his Ph.D. in Operations Research from the University of California at Berkeley. He started this fall as an assistant professor in the department of Engineering-Economic Systems at Stanford University. . . . **Kenrick Campbell** is working at Traveler's as an actuarial assistant in casualty-property. He and his wife Lois have two children: Robyn Ann (4) and Eric Andrew (2). . . . **Joseph Sacco** writes: "Finishing residency in medicine . . . plan to spend next year working part time in ER, and then Gail and I are going to Europe. . . until we run out of money. Then plan to start cardiology fellowship—more of the 'perpetual student' syndrome!"

After completing some work on wave making equipment at Edinborough, Scotland and in Holland, **Glenn Keller** went on a tour of Africa this past summer with a group of English friends using a British surplus 'lorry'; I would like to thank his father, Mr. Jim Keller, for relaying this item to us. . . . Finally this: **Dr. Walter Lapatovich** married prominent socialite, Penny L. Haynie of Acton, Mass., in a small ceremony on April 24, 1982. Close friends and family attended.—**Alex Castaldo**, Secretary, 929 Mass. Ave., (12D), Cambridge, MA 02139

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It is with great sorrow that I must report the death of **Gordon Fulton**. Gordon passed away on July 10. An electrical engineering major, he resided in East Campus, as did your secretary, who knew him. Our condolences go out to his parents, the Reverend and Mrs. Joseph Fulton.

From the mails: **Julie Ann Olson** has received her Ph.D. from Rockefeller University in parasitology. She studied the mechanism by which human malaria parasites infect red blood, and she is now doing postdoctoral research in the department of experimental hematology at the Albert Einstein College of Medicine. . . . Dr. **Lynne R. Richardson** was the guest speaker at the Minority Awards Program held on May 13, 1982. She is currently a resident in internal medicine at Harden Hospital in New York City. . . . **Peter Manzella** is "employed by High Technology Systems, Inc. of Hopkinton, Mass." His second son, Aaron, was born on New Year's Day, 1982. Contrats. . . . **Steven Spura** reports that he "has moved to the Providence, R.I. area, and to a new job at Providence Metalizing Co. The job is a real challenge, bringing in diverse interests and needs for the company." From **Mark Suchon**, "July marks my one-year anniversary with Teneco Oil Processing and Marketing. I will simultaneously make a sideways move from marketing planning into refining and gas process planning."

Alan Levin is currently a vice-president of Chase Econometrics/Interactive Data Corp., a joint subsidiary of the Chase Manhattan Bank. Major work activities include working with field sales and coordinating systems and analysis consulting projects for major corporations and financial institutions. He says, "In December 1981, my wife gave birth to a baby girl, April, who is filling our daily lives with many joys. Overall, Boston life is going well." . . . **Jim Miller**, while at the University of Alaska, Fairbanks, was named the outstanding student in engineering science management. While there, Jim was studying computer message systems. . . . And from **Jeslie Charmak**: "I've moved back to California where I've decided to take the (financial) plunge and try my hand at real estate—I bought a small townhouse in Sunnyvale (the "heart" of Silicon Valley). Working for Hewett-Packard in Cupertino, I meet M.I.T.ers quite often. Along with **Wendy Peikes** and a bunch of others, I've made aperiodic visits to San Francisco for Chinese food at the Hunan Restaurant (closest

thing to Joyce Chen's in quality) and Gelato's for cooling ice cream afterwards. Actually found a place that has to be dear to all our hearts. Yes, Missouri, there is a *Smoot* (population 100), and it is alive and well (?) in California.

I had a phone call from **Dominic Zito** who was briefly in the U.S. Dom is attending medical school in Catania, Italy. He also translates articles from English to Italian for a local paper. On the way to Catania, Dominic got an M.S. in microbiology from Wagner College in New York City and a degree in neurology in Madrid.

Your secretary had a delightful day with **Dan Dershowitz** and Debbi Gross, '77. They were in Greenwich Village for the Labor Day Art Festival. Debbi is with General Foods, not Halcon International, which is the company for whom Dan works. We had an excellent day browsing among the various arts and crafts, and did a little reminiscing. It surprised us all to how much time has elapsed since when we first set foot at the 'Tute.

As for your secretary, he has had a difficult and amazing time coping with the Henry Kaufman-inspired rally. Between bonds and stock index futures, it is, to understate it, a rough trading environment. And there have been pyrotechnics in the foreign exchange and precious metals markets, as well. These are very exciting times to trade commodities. Social and economic unrest are great market movers, and when a market moves it is the siren song of trading calls. However, these days one must make sure one is not caught by Scylla or Charybdis. So far, I am still managing to sail largely in between.—**Arthur J. Carp**, Secretary, 15 Jones St., Apt. 3D, New York, NY 10014, (212) 741-3023

77

Glenn Brownstein is still a sportswriter for the Belleville, Ill. newspaper—a 50,000-circulation St. Louis suburban daily, but is going "big time" this winter as the beat reporter for the St. Louis Steamers, the pro indoor soccer team. Glenn hopes it's just a short leap from there to "Inside Sports.". . . **Jeffrey Gertz** is now back at M.I.T. working on his doctorate at the Gas Turbine Lab. . . . **Deborah Hoover Dobson** is in Houston working for Exxon in subsea oil systems. Deborah and her husband, Jeff, have two sons, ages 3 and 1. . . . **P. Nsuiakaramahawonsse** is now a senior design engineer at ITT, in Van Nuys, Calif. He is developing an air defense simulator consisting of radar networks and weapons delivery systems land-based and shipboard use.

Andre K.Y. Au has joined Signature Interests, a Boston developer, as a project manager. His current project involves the renovation of a downtown Boston building into first-rate offices. . . . **Robert Harrington** has finished his M.B.A. . . . **Joel Lederman** has recently moved to California to join Magnetic Technology in Canosa Park, as chief mechanical engineer.

I hope to see more news from our class—but it's not considered appropriate to invent it. Please do try to get a note off to me in the next few months. I know you're busy, but I am also sure that you look forward to seeing yourself and your friends in the notes. Until next month.—**Barbara Wilson Crane**, Secretary, 6431 Galway Dr., Colorado Springs, CO 80907

78 5th Reunion

Good evening. Unfortunately, I didn't receive very much in the way of news from you folks this month. However, I do have something of a backlog from previous columns, so I'll be able to report something.

And now the news. **Bill Lull** writes that he recently changed jobs—he's now working for Syska and Hennesy, where he is helping organize a conceptual design group which will aid their offices in design of mechanical and electrical systems for major building projects. While he was in between jobs, however, he kept himself busy by working on a design of the energy generation system for a wind turbine sculpture in Florida.. . . **Jack Lissauer**'s Ph.D. dissertation in applied mathematics is on Saturn's Rings. He's working with a thesis advisor at Berkeley who is M.I.T., '63, and he's rooming with two of our classmates, **Dan Halbert** and **Neil Soiffer**, both working on their doctorates in computer science. Another Berkeley-ite, **Ken Kellogg**, took his master's in mechanical engineering and ran—to L.A. There he's working as a "fire fighter" for Rocketdyne. Ken keeps in close touch with classmate **Charlie Mobbs**, who is also in L.A., working on his Ph.D. at the University of Southern California.

To interject a couple of brief editor's comments, a couple of simple steps will keep me from fouling up your news too terribly. First always print your name clearly. (I have a card from a married pair of classmates, but I can't read their names. They are M.I.T. grad students, and their child's name is Yaacov Yoseph. Congratulations—if only I knew your names.) Second, please put a current date on all communications. Often, by the time things make it into the column, I don't know whether to put the news into future or past tense. Perhaps I should just use the pluperfect subjunctive. And I will, if you don't date things. Thanks.

Here's someone with a legible signature, **Herman Lee Marshall**. Herman and his wife (Jen?) both bike to work from nearby Medford, Mass. Herman's thesis on optical and x-ray observations of quasars is going well and will hopefully be finished soon. But, just in case he gets bored with science, Herman has gotten involved in Harvard grad student politics—he's now chairman of the Graduate Student Council. . . . **Richard Fagin** writes, "I have returned to Corpus Christi after two rather unpleasant years in Houston. Maybe this time I'll stay longer than a month! I have also returned to exploration (oil and gas) as Conoco's district geologist here, where most of the production staff were once my students in basic well logging." (Editor's note: a very popular course at Corpus Christi) He continues: "See y'all down on Padre Island—I'll be driving a black 1965 Corvette (with the top down, of course)!"

From the wilds of New Jersey writes **Robin Schlinger**, who Mobil Chemical recently promoted to research engineer and transferred from Edison to Pennington, N.J. . . . Fellow Jersey-ite **Donald Mellen** wrote to me from Whippany, where he's been working for Bell Labs since graduation. Don's big news is his baby girl, born to him and his wife Anne Pida last October. . . . And moving across to the Hudson, there's **Tom Ozemko**, in White Plains, N.Y. Tom, who's working for AT&T in WP, got married last April and had classmates **Michael Cahen** and **Neal Sahima** as attendants in his bridal party. . . . **John Marcou** and Dr. **Rosebeth Rosen** were married May 30 in Boston (Natick really) and are now living in Menlo Park, Calif.

In the "Windy City" (Chicago, not Cambridge) there is **J. Kevin Mann**, who's in the middle of his second year at the University of Chicago Graduate School of Business—and loving it. "The program is tremendous and the people a delight." . . . Also in Chi-town is **Amy Powell**, who has taken over responsibility for real estate development in her firm. When she wrote, she was building a suburban office park and neighboring industrial facilities. . . . And, not too far away, in the frost-bitten northland, **Stephen Pratt** wrote to tell us that he is now vice-president for membership for the M.I.T. Club of Minnesota.

Now for some medical folks. **Neal Rockowitz** writes his good news: "Newly married on June 5, 1982 to Laura Lappas of Montreal (Air Canada flight attendant) and starting surgery residency at Harbor-UCLA Medical Center. **Mike Mannes**, **Bill Fejes**, and **Steve Stein** all attended the wedding!" . . . **Bob Desai** writes that he is now a resident in radiology at Georgetown University after having completed a year's internship at Newton-Wellesley hospital. . . . **Barry Linder** made it into the local papers in Berkshire County, Mass., when he won a Berkshire District Medical Society scholarship loan to help out while he studies at Washington University Medical School in St. Louis. The only lawyer who wrote to me was **Steve Borek**, who spent his first year out of law school clerking for U.S. District Court Judge C. Clyde Atkins, the chief judge of the federal court in southern Florida. When he leaves that post, he hopes to return to New York, where he got his J.D.

Back to New England, **David Loo** writes that he is "doing fine," working for Analytic Sciences Corp. in Reading, Mass., and reverse-commuting from Boston. . . . **Connall McCabe** wrote to say that his former roommate, **Mike Mauel**, got married last December. (That was no news to me—Mike's wife, Allison Moore, Simmons, '78, went 4 for 4 against my softball team) Connall writes: "Needless to say, Mike and I don't share the apartment anymore. For the occasion, I heard that **Jon Rogers** (still with P&G in Cincinnati), **Arnie Aigen** (finishing up medical school in New York City) ushered at the wedding with **Jeff Palmer**, who is in his second year at Harvard "B" School. Me? I took up sky diving this past summer. It helps pass the time."

More New Englanders. **Peter Moss** writes that he is at Bolt, Beranek, and Newman in Cambridge, working on acoustical signal processing. "Lots of good hard work, yet still time to play." . . . And, being very New England, there's **John Arrison**, who writes from Bath, Maine as follows: "Having received an M.A. in history at Brown University in 1981, I can confirm that a liberal arts education is much more useful than a technical education, even in the technical environment of shipbuilding at Bath Iron Works. I am continuing work on the side in maritime history research and sea music of the 19th century."

So much for other people's news. My big news, of course, is that our softball team made it to the finals of the M.I.T. junior division of the serious slow pitch league. Contributing to this magnificent effort were classmates **Karyn "The Enforcer" Altman**, **Jim "The Little Bingo" Bidigare**, **Craig "The Man" Wallach**, and **Alfred Wendolyn "The Kid" Chock III**. The other news is that I'm getting marrieid in two weeks. . . . Now, I want you all to write! I'm all out of new news, and I'd hate to see the libel suits for the news I'll have to make up. So, until next year's softball season, this is **David S. "Lefty" Browne** wishing you all a cozy winter. Write or call at 50 Follen St., No. 104, Cambridge, MA 02138, (617) 491-5313 or work, 523-11005

79

Greetings from the Windy City! As I write this, I am completing my second month in Chicago, and am enjoying the summer delights immensely. By the time you *read* this, however, winter should have started to set in, and I will be fervently wishing for my six-month stint to be at a close! . . . Important: The Class of '78 Reunion Committee is considering opening the festivities at their reunion next year to other recent classes, including ours, since so many of them have friends in our class. We need to determine what kind of response they can expect. If you think you would be interested in attending, *please* drop me a line. No commitment required—this is just an enthusiasm poll. Thanks!

Rick Halvorsen is clearly one who does not shun colder climes. Rick just graduated from the University of Michigan Law School and has endured the bar exam. He plans to practice law in Seattle. . . . **Virginia Chen** has also said goodbye to student life. Virginia graduated from Mount Sinai School of Medicine in New York City in June, and started her internship in surgery at New York University/Bellevue Hospital Center in July. . . . **Earl Lipson** just finished his master's degree from the Sloan School. He will be vacating his Beacon Hill apartment with a roof-deck view of the Charles, to move back to Toronto and begin work there. Earl sends regards to the "Burnside Boys" and the "Bay State Clan." He says, "I'll return to Boston for C.J.V.R.'s wedding this fall" . . . Many congratulations to Rick, Virginia, Earl, and all the other recent graduates who have been too busy collecting their first paychecks to write me. (I'm subtle, aren't I?!)

More congratulations are in order to some newly-marrieds. **Emerson T. Knowles** reports that he is happily married since November 1981, and is still having fun in the investment business. . . . **Ron Parton** was married on August 13 and had many M.I.T. grads in attendance, including **Ken Keverian**, **Bob Light**, **Marcus Julian**, **Amy Powell**, Tom Gilbert, '78, and Ed Michelson, '78. Ron is in his fourth year

at University of Iowa Medical School, but has structured his year so that he can spend most of it here in Chicago, where wife Kathy is a teacher. Ron plans to go into family practice.

Still more congratulations: **Eileen Mannix** is now the proud owner of a two-bedroom house in Richmond, Va., where she has been stationed with duPont since April 1981. . . . **John Stautner**, a grad student at the M.I.T. Experimental Music Studio in a new master's program in music and technology, is the first recipient of the William L. Hsu-Friends of Music at M.I.T. Prize for music competition. A letter from Prof. John Harbison, chairman of the M.I.T. Music Section, said, "This prize is awarded both for your piece, 'They Took the Crosstown Bus', and for your resourceful work in assisting and facilitating composer participation in the Experimental Music Studio over the last three years." John has been doing work on simulation of acoustic ambience, and also studies the music of India.

Charlie Bright writes, "Presently reassembling 514MW Westinghouse steam turbine HP/IP section at Boardman (locally known as Boredom), Oregon! This unit is a lemon. Row 5 on the HP keeps failing. Finally it was removed and a baffle installed, but we have just finished reblading with a different technique. I'd give it a 10 percent chance of working. Westinghouse really doesn't know what's wrong with it. Nevertheless, I am enjoying Seattle area's cool greenery during limited time off. Will be watching the hydro races next month. Lots of people and fun. Also planning on advanced degree at University of Washington, Seattle starting this fall." . . . **Mimi Fuhrman** is in a Ph.D. program in geochemistry at State University of New York at Stony Brook, having received her M.S. from there in June 1981. Mimi writes, "I'm very much looking forward to my first field season in the beautiful (but, unfortunately, hot!) desert near Laramie, Wyo. I'll be spending the entire summer there. Life at Stony Brook will be greatly enhanced in September when my buddy, **Dorothy Comeau Fuhrman**, will be living here. Dorothy is now not only my good buddy, but my sister, too, having married my brother Jed Fuhrman, '77, last summer. Jed's a professor at Stony Brook now, so they're planning to stay here for a while. I'd love to hear from any fellow geologists out there—especially **Mary Haselton**."

As for me, I'd like to hear from any fellow *people* out there—isn't anybody listening??? Sigh. The class secretary's lot is not a happy one. Write and cheer me up—**Sharon Lowenheim**, Secretary, 131 E. 83 St., Apt. 2G, New York, NY 10028

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By the time you read this column, the year will be drawing to a close, so best wishes to all of you for a happy holiday season. Congratulations are in order for **Ray Nagem**, who along with five other M.I.T. students, has been selected as a winner of a Ragnar D. Naess scholarship that will provide private lessons for instrumental study. The scholarships are underwritten by the recently established Ragnar D. Naess music fund in cooperation with the M.I.T. Council of the Arts, and are to be used to advance music at the Institute. Ray is currently a mechanical engineering graduate student and a pianist in the Chamber Music Society.

Mark Connaughton writes in from the L.A. area, "For the past two years, I have been doing detail designs for the space shuttle main engine uprating, I am now transfering to advanced projects at Rocketdyne." . . . **Michael Benjamin** reports that he is "having fun managing a restaurant on beautiful Mackinac Island, Michigan." If you're in the area and happen to drop by, I'm sure he can get you a good table. . . . And if you're in the Boston area, be sure to tune in to WMBR (88.1 FM) on Sunday evenings to catch the *Good News* radio program produced by **Samuel Nixon, Jr.** Other activities keeping him busy include lecturing with the New England Small Business Summit on "Leveraging Technology for the Bottom Line," and assuming the vice-presidency of the Boston Urban Business Forum. . . . This past summer, **Terry Neiman** celebrated his first paycheck with a party in Venice, Calif. Terry writes in, "For the record: I just received my M.S. in materials science and engineering from U.C.L.A. (fight-fight-fight!). I'm living in Venice and working at the TRW Microelectronics Center in Redondo Beach (surf's up!)." He also claims to have the best parties in West L.A.; if any of you were there, let me know. . . . I received a very nice letter from **Eric Caplan**, who in March 1982 received his master's degree in engineering mechanics from Virginia Tech and is now living in Marietta, Ga., while working for the Lockheed Georgia Co. Over the past few months he has been pursuing a variety of projects related to Lockheed's cargo airlifter production. Of his life-style Eric writes, "I'm adjusting to Atlanta, which is a wonderful city. But being a native Bostonian, I have to get used to sane drivers, summer humidity, and furniture salesmen who urge you on their T.V. commercials to attend church this Sunday. And, oh yes, I'll take lobster over peaches any day."

Overheard at the Blue Parrot in Harvard Square: **Tom Varney**, with the U.S. Navy, has submarine duty in Italy and will be piloting his craft back to the states this fall. . . . **Paul Hajian**, having recently completed his master's work in architecture, plans to work for his father's firm in Boston. . . . **Eric Balles** is now at M.I.T.'s Sloan Engine Laboratory. . . . Overheard at the First and Last Chance Bar, Oakland, Calif.: **Ricardo Sitchin**, with Chevron Research, has acquired a Ford Lynx and has become an avid scuba diver as well. . . . **Ralph Hulseman** is taking a position in fibers and adhesives research with Michelin Tire in North Carolina beginning this fall. . . . Overheard 32 floors atop the S.F. financial district: **Gerry Applestein**, happily engaged to Petra Weller, is Exxon's oil loss coordinator at the refinery near Baton Rouge.

That's the last of the news in 1982. Keep in touch. (Note my change of address—I have left S.F. and moved back to Boston, upriver, to attend Harvard Business School.)—**Debra A. Utko,** Assistant Secretary, 13A Soldiers Field Park, Boston, MA 02163

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A lot of folks took some time out this summer to drop the class secretary a line. Thanks, it's appreciated.

Our classmates in the working world have started out on a variety of career paths: **Robert Tulman** is an electrical engineer at Honeywell EEO in Lexington, Mass. . . . **Linda Laatsch** is "working as a psychologist at Massachusetts Hospital School, doing neuropsychological assessment and therapy with children that have progressive diseases or have had brain damage from birth." . . . **David Bedrosian** is currently working as a "scientific programmer for Contrex, Inc., a small, young company developing automatic visual inspection equipment." . . . **Bill Flarsheim** writes that he is working for M.W. Kellogg Co. in Houston, Tex. Bill comments, "It's a lot warmer here than it ever was in Boston in the winter, but the skiing's not very good." . . . **Rudolph Alexander** is manager, administrative staff for AT&T. Rudolph is responsible for personnel matters and general administration of the Central Region, based in Chicago.

Striking it out on his own, **Thomas Klein** has begun a consulting business, Thomas Klein Associates, here in Cambridge. Tom consults to young technology-based ventures on the subjects of marketing strategies and raising capital. . . . **Ellen Fischer** writes: "I'm managing city-owned buildings as part of a community group in Williamsburg, Brooklyn and working to develop mixed-income housing. Also studying karate."

I received a letter from **Steve "Laser" Lazar**. Steve writes, in part: "After graduating, I took a job as a legal assistant at a law firm on Wall Street and moved into the city for a while. I just quit my job (joining that happy 10 percent of our nation's population who are unemployed). I'm planning on doing some traveling for the summer and will be starting at Duke Law School in the fall. Looking forward to hitting the books, strange as that may seem, (secretary's note—soon you probably won't believe you ever said that, Steve), and especially to leaving the Northeast for the first time."

Like Steve, other classmates have elected not to contribute to the Gross National Product and are also pursuing graduate degrees: **David Powsner**, also in law school, is attending Case Western University. David "spent last summer in Ann Arbor, Mich. working at a computer company and has run into **Jim Askey**, who is a mechanical engineering master's candidate at the University of Michigan." Also at Case Western, **Eric Neumann** is in his second year of graduate school in the Pharmacology Department (Ph.D.), pursuing new schemes for genetic cloning. . . . **Carlos Arcos** is "having a great time as a first year M.B.A. student at Wharton." . . . **Yu Lung Chu** is working on his master's in electrical engineering at CMU.

Several class members are at U.C., Berkeley: **Mark Radka** is "working on a master's in civil engineering and living with ex-Bakerites, Ricardo Sitchin and **Jon Pelz**.. . . **Jim Berets** writes that between earthquakes he is working on his master's in electrical engineering at U.C. Berkeley, and living with East Campus (Second East) friends, David Goldhaber, '80, and **Tom Gaul**.

So much for academics. A few of our classmates are becoming quite worldly as their jobs and interests take them to various countries. (The postcards they send are real' nice). **Stephen Skiest**, who's working for Fairchild in South Portland, Maine, just got back from a three-month temporary assignment in Singapore. . . . **Debye Meadows** of WILG fame is living near Tokyo, Japan, doing environmental engineering for the U.S. Air Force. Debye writes that she finds her job interesting and is also working on an M.P.A. and teaching college math (both part time). . . . **Jim Madsen** sent a postcard from Mazatlan, Mexico. Jim is currently a nuclear safety consultant for EDS Nuclear in San Francisco. Jim, who commutes to work by ferry every morning, has a house "in Sausalito perched on the side of the hill with a 270-degree view of the bay." Jim, who obviously leads a tough life, spends his free time windsurfing on SF bay, playing racquetball, and skiing. Jim cordially invites any of his Zeta Psi brothers to come out and visit.

I have received news of several weddings. Congratulations to all. **Thomas Eccles** was married to Jennifer Colagiuri (Wellesley, '81) and is now serving as a sonar officer aboard the U.S.S. *Richard B. Russell* (SSN 687), a fast-attack submarine, homeported in San Francisco. . . . **Tony Wilson** recently married Judy Griffiths.. . . **Ted Equi** writes that he has "started work for Digital in their LSI facility in Hudson, Mass., started in the industrial master's program at M.I.T., and married Karen Sabnico and started a life of enjoyment."

And last but not least, can't forget **Michael Wilson**, who simply wrote that he spent this past year "being a graduate student." Until next issue.—**Chuck Markham**, Secretary, 362 Commonwealth Ave., No. 2E, Boston, MA 02115

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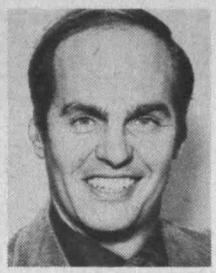
Postcard-of-the-month award goes to **Mark Schmaier**, **Eddie Torres**, and **Mat Womack**. They sent me a great one from the Grand Canyon. (Of course, it was the only postcard I got—besides the orange ones, which don't count—all month and it took all three of them to send me one postcard. But it's still better than a lot of you are doing. When are you going to write? Anyway, they said they wanted to get as far away from the Institute as possible (I can't imagine why) and their next stop is L.A. Has everyone headed west?

Bill Dawson wrote to let us know he's working for Hughes Aircraft in El Segundo, Calif. He says **Michelle Hunt** is also at Hughes and that **Mark LaRow** and **Chris Moran** are doing master's work there. Bill also tells us that **Mark McQuain** is at Ohio State Medical School, **Gary Kratkiewicz** is at Arthur D. Little, and **Maria Petrocchi** is with Ford Aerospace in Newport, Calif.

In the "who-needs-sunshine-and-I-never-got-enough-snow category" is **Rodney Robertson**. No sunny southern Cal for Rodney, he's working for Standard Oil in Alaska. . . . **Doug Barowski** is engaged to Dianna Psyras. Congratulations!—**Rhonda Peck**, 38 Bigelow St., Cambridge, MA 02139

R. R. Patel



N. Didriksen

Raju Patel Joins the Alumni Association as Directors Shift

Rajeshwari ("Raju") R. Patel, S.M.'77, has joined the Alumni Association staff as regional director for New England.

Ms. Patel succeeds Paul E. Johnson, who has become regional director for the Gulf/Atlantic region. Regional directors are responsible for the support of alumni clubs and Alumni Fund activities in their regions, as well as of special activities such as the M.I.T. Enterprise Forum and the Boston Seminar Series.

Ms. Patel received degrees in physics and law from Baroda University, India, and then came to the Sloan School of Management's Master's program. She has been an intern at the Centre for Transnational Corporations at the United Nations and an officer of the Industrial Credit and Investment Corp. of India, Ltd. A certified public accountant, Ms. Patel was an auditor with Price Waterhouse and Co. before taking her current Alumni Association post. She has been an active member of the Association of M.I.T. Alumnae (AMITA) and is currently its treasurer.

Didriksen Named as Associate Fund Director

Neil Didriksen, who has been involved in fund-raising for educational organizations in the Greater Boston area for more than ten years, is now associate director of the M.I.T. Alumni Fund. He succeeds Nancy Russell, who has left the Alumni Association staff to live and work in the Pittsburgh, Pa., area.

Mr. Didriksen's most recent experience has been with the Thompson Island Education Center in Boston. Earlier, while a member of the staff at the University of Massachusetts, Mr. Didriksen directed a consortium of the public colleges in Boston for resource development activities. He has worked in both major and annual giving programs involving both staff and volunteer leadership.

At M.I.T., Mr. Didriksen will be providing staff support to all activiites of the Alumni Fund as the principal assistant to Joseph S. Collins, director of the fund.

Mr. Didriksen is a graduate of Haverford College (B.A. 1970).

A Major Commitment by Grace to M.I.T. Microbiology Research

W. R. Grace and Co. will provide M.I.T. with between $6 and $8.5 million during the next five years to support research in microbiology—a significant evidence of the growing trend on the part of major corporations to sponsor basic long-term university research in areas underlying their industries, said Paul E. Gray, '54, president of the Institute.

Eighty percent of the funds will be spent on projects proposed by members of the M.I.T. faculty and approved by Grace, and 20 percent will be available to M.I.T. for use on microbiological research at the university's sole discretion. Grace will have free (and in some cases exclusive) use of patents and copyrights resulting from the work, though all patents and copyrights will be held by M.I.T. in accordance with its sponsored research policy.

Grace's support is motivated by the company's desire to "work with the best available people on fundamental technology concepts," according to Robert J. Kunze, senior vice-president and executive for the company's Corporate Technical Group. It's part of Grace's strategy for expanding its participation in biotechnology and industrial microbiology.

The Grace-sponsored research will focus on microorganisms "whose life cycles result in the production of recoverable amounts of promising or recognized biochemical compounds and on chemical methods of separating and purifying the products," according to the M.I.T. announcement. Gene splicing and other techniques of genetic technology are likely to be used, with new amino acids and enzymes being likely end products.

Grace has been the recent sponsor of three projects in the Department of Nutrition and Food Science, all relating to the production and utilization of amino acids or their precursors. These projects will now be part of this larger Grace-sponsored program.

President Gray welcomed the program not only for its financial support in a time of decreasing federal commitments. He believes that industry-university collaboration such as that established between M.I.T. and Grace can help speed the transfer of innovations from laboratories to productive use.

In addition to nutrition and food science, three other departments are expected to receive major funding for research from Grace—chemistry, biology, and chemical engineering. In addition, a number of interdepartmental activities are likely to develop, according to Kenneth A. Smith, '58, vice-president for research who was responsible for detailed negotiations with Grace on the new program.

Making enzymes work for man. Professor Gerald N. Wogan (left), head of the Department of Nutrition and Food Science, with three experts in enzymes gathered for a symposium in honor of Professor Ephrain Katchalski-Katzir, winner of the 1982 Underwood Prescott Award. Left to right: Richard I. Mateles, '56, of Stauffer Chemical Co.; Dr. Katzir; and Professor Klaus Mosbach of the University of Lund (Sweden).

Enzymes: Catalyzing a New World of Foods and Pharmaceuticals

Distinguished contributions to the science and technology of enzymes brought Ephraim Katchalski-Katzir, former president of Isreal who is now Institute Professor at the Weizmann Institute of Science and head of the Center for Biotechnology at Tel Aviv University, the Underwood-Prescott Memorial Award at M.I.T. on September 22.

Simple enzymes—catalysts that bring about biochemical reactions in living cells—are an old story to Dr. Katzir, whose interest in proteins and biopolymers has been almost life-long. After making many contributions to conventional enzyme chemistry, Dr. Katzir and his group pioneered the concept of immobilizing enzymes in order to control the timing of their catalytic action—a concept that has led to several significant industrial applications including the production of fructose syrups from glucose. (That process is now so successful that the U.S. has largely withdrawn from the world sugar market.)

But all these technologies are reaching maturity, Dr. Katzir said at a symposium in connection with the award. Tomorrow's action will be on "a new generation of complex enzymes and co-enzymes" capable, for example, of transporting electrons and completing oxidations. Within a decade, Dr. Katzir said, they will be used to create or modify "an enormous number of chemicals."

There will be important medical applications, too, said Professor Klaus Mosbach of the University of Lund, Sweden, at the symposium. He foresees the use of immobilized enzymes attached to microorganisms for treating diseases—including viral infections. The insulin from pigs requires but one structural change to be identical with human insulin, and that change can be accomplished by enzymes; enzymes in this case are pitted against genetic technology in the race to increase the supply and reduce the cost of insulin. But genetic technology may also have a vital role in the development of new enzymes and in increasing their availability, said Professor Mosbach.

Despite these marvels, no one is yet finding exciting financial returns in the growing business of making and selling enzymes—now about $500 million annually in the U.S. That's because it's a capital-intensive business, said Richard I. Mateles, '56, vice-president for research at Stauffer Chemical Co., at the symposium—and because that sales volume is spread over perhaps 1,000 different enzyme products. The profit potential in applied enzymology in the future, suggests Dr. Mateles, is tied to a "systems approach"—selling not enzymes themselves but making and utilizing enzymes to produce uniquely profitable new food and drug products.

At the end of the day, Dr. Katzir waxed philosophical: the significance of enzymes in the longest view, he said, will be their crucial role in helping man live in the closed system that is planet earth. Recycling will be the key to our survival, and enzymes are the best catalysts we know for the chemical processes through which biological materials can be recycled.

A Disc That Really Takes You Back

Nostalgia flows just as freely as the title implies in a new recording called "Take Me Back to Tech," now available from the M.I.T. Museum.

On one side, introduced by the late Dean Everett Moore Baker, are songs by groups such as the Dodd Singers and the M.I.T. Glee Club dating back to the 1940s, 1950s, and 1960s. On the other side are modern versions of some of the same songs by today's M.I.T. Chorallaries, a mixed "barber-shop" group. Included are "Arise Ye Sons" and "Take Me Back to Tech"—and some old-time memories: "Mother Was a Tech Coed" from Tech Show 1954 and "Grimy Cambridge Air," the Senior House entry in the All-Tech Sing of 1966.

Copies of the record, whose production was a joint project of the Museum, the Chorallaries, the Alumni Association, and the Council for the Arts, are $5 each from the M.I.T. Museum, Room N52-260, Cambridge, Mass. 02139.

A. F. Friedlaender

Friedlaender Named New Head in Economics

Professor Ann F. Friedlaender, Ph.D.'64, an expert in public finance who specializes in transportation studies, will be head of the Department of Economics effective in 1983. She succeeds Professor E. Cary Brown, who has been head of the department for more than 15 years and will now return to full-time teaching and research.

Professor Friedlaender has dual appointments in the Departments of Economics and Civil Engineering, and she has been associated with the Center for Transportation Studies in a number of recent research activities; she's been associate head of the Department of Economics since 1981.

A graduate of Radcliffe, Professor Friedlaender returned to M.I.T. in 1974 after one year in Finland and nine years as a member of the faculty at Boston College. Her recent research has been on the economics of the U.S. automobile industry, the effect of regulation on the productivity of the trucking industry, and investment criteria for transportation. She has written a number of books and monographs on these and other subjects, and she has contributed to a number of studies in economics and public affairs.

M.I.T. alumni at Qinghua University, China, photographed as four members of the university faculty entertained a visiting alumni group on a three-week China tour in 1981. A similar tour, with many opportunities to meet M.I.T. alumni who now live and work in China, is being planned for October, 1983. (Photo: Leonard F. Newton, '49)

Touring China with a Difference: Among the Hosts Will be Alumni

Up to 30 M.I.T. alumni, spouses, and guests will spend three weeks in the Peoples Republic of China leaving the U.S. on October 12, 1983—a tour especially arranged to include visits with M.I.T. alumni in China and a tour of Qinghua University, the M.I.T. of China, as well as most major cultural and historical features.

There will be visits to Shanghai, Hangchow, Beijing (Peking), Xian, Kwelin, and Canton. Entry into China will be from Tokyo with departure through Hong Kong.

Leonard F. Newton, '49, and Mrs. Newton, coordinators of the trip, emphasize the special advantages of the Institute connection. Building on a 1981 trip, the 1983 tour will provide social contacts in both Shanghai and Beijing with M.I.T. alumni who are living in China. "They represent a unique resource not afforded other China visitors," say the Newtons in the prospectus for the tour. "They can provide important insights on what we should look for as we move through China. Our dialogues together could be a high point of the trip," they say.

Other highlights: escorted tours of the Great Wall, Imperial Palace, Summer Palace, Ming Tombs, and the newly excavated Emperor Qin Tomb; boat trips on Hangzhou's West Lake and Grand Canal; visits to museums displaying China's finest art as well as factories, communes, and hospitals; and musical, artistic, and cultural attractions as options.

For further information: Leonard F. Newton, '49, 90 Dempsey Ave., Princeton, N.J., 08540, or the tour organizer, the Quarter Century Club, Room 20A-023, M.I.T., Cambridge, Mass. 02139.

M.I.T. at Lake Woebegone

New Year's Day 1983 will be special for the M.I.T. Club of Minnesota: M.I.T. students home for the holidays will join members of the club in the audience for the Prairie Home Companion radio show originating in St. Paul on that day for live broadcast on National Public Radio.

The show specializes in a colloquial formal built around the village of Lake Woebegone ("the town that time forgot, that the decades cannot improve, and where all the children are above average"), and Lake Woebegone's mail bag of messages and information about the outside world as explored by host Garrison Keillor is a major feature of each show. Alice E. Cowan, '78, who is vice-president of the Minnesota club, says the high school of Lake Woebegone has no trigonometry class; nevertheless, she says, the Minneapolis-St. Paul alumni expect to find a student who will be the first Woebegonian to attend M.I.T.

Alumni are invited to tune in—and to send their own messages to be in Lake Woebegone's mail bag on January 1.

UPS Transportation Grant

A $550,000 gift for program support has come to the Center for Transportation Studies from the UPS Foundation, created in 1951 by the United Parcel Service of America, Inc. Professor Daniel Roos, '61, director of the center, says the funds will be used for studies of private-sector and management-oriented problems in transportation. It's the fourth in a series of grants to M.I.T. from the UPS Foundation since 1978 for transportation teaching and research—"really terrific support," says Professor Roos.

Norman J. Padelford, 1903-1982: Dumbarton Oaks and the United Nations

Norman J. Padelford, who had been a member of M.I.T.'s political science faculty from the end of World War II until his retirement in 1974, died at his retirement home in Claremont, Calif., on July 13; at 78 he was the victim of a stroke suffered early this year.

Professor Padelford was called to serve as a consultant to the State Department in 1942, while he was professor of international law at Fletcher School of Law and Diplomacy (Tufts University). For the next seven years he worked with a group appointed by President Franklin D. Roosevelt to draft the charter of the United Nations, the international agency which the president envisioned as the political outcome of World War II. Professor Padelford was a member of the U.S. delegation to the Dumbarton Oaks conference in 1944, and a year later he was executive officer in charge of drafting the statute for the International Court of Justice at the U.N. conference in San Francisco.

Professor Padelford joined the M.I.T. faculty in 1948 to organize a new department and doctoral program in political science, and he served as chairman of the department from 1958 to 1968. Thereafter he was a member for one year of President Nixon's task force on oceanography, working on the U.S. participation in the Law of the Sea conference. He retired in 1974.

A native of Harverhill, Mass., Professor Padelford held degrees from Harvard and taught at Colgate University from 1929 to 1936.

John T. R. Nickerson, 1906-1982

John T. R. Nickerson, '32, a member of the staff in food technology from 1948 until his retirement in 1972, died on August 16 at Wareham, Mass., following a brief illness; he was 76.

Professor Nickerson made significant

research contributions in the fields of food processing, preservation, and sanitation during his years of service on the faculty and as a graduate student; he held both master's (1934) and Ph.D. (1938) degrees from the Institute. Before returning to the Institute in 1948, Professor Nickerson was for five years chief chemist at the Birdseye Co. and later held the same post at Hygrade Food Products.

William E. Krag, 1928-1982

William E. Krag, '50, a specialist in solid-state physics at Lincoln Laboratory, died on August 26 of cancer; he was 54.

Dr. Krag's most recent assignment at Lincoln was in connection with electro-optical sensor systems for space surveillance. An avid outdoorsman, he was president of the M.I.T. Outing Club as an undergraduate.

Harold S. Gulliver, 1963-1982

Harold S. Gulliver, III, '84, an undergraduate majoring in aeronautics and astronautics, died in Atlanta, Ga., of accidental injuries on August 14; he was 19.

Mr. Gulliver was a resident of MacGregor House, where he was active in house and intramural affairs.

Deceased

George W. Prentiss III, '05; June 16, 1982; 153 Madison Ave., Holyoke, Mass.
Robert S. Pinkham, '06; August 6, 1982; 73 Union St., South Weymouth, Mass.
Francis C. Atwood, '14; July 31, 1982, PO Box 68, Edgartown, Mass.
Albert C. Sherman, Jr., '14; August 3, 1982; 177 Winchester St., Newton Highlands, Mass.
Leonard S. Besly, '16; July 19, 1982; 28 Pickney Rd., Red Bank, N.J.
Walter L. Medding, '17; June 16, 1982; 6010 Dinwiddie St., Springfield, Va.
John W. Clarkson, '18; August 14, 1982; c/o Hermitage Nursing Home, 311 Mill St., Worcester, Mass.
Rolfe A. Folsom, '18; May 5, 1982; 1156 Grimley Ln., San Jose, Calif.
Edwin Wallace Neff, '18; June 8, 1982; 555 S. Orange, Pasadena, Calif.
Donald W. Kitchin, '19; July 30, 1982; 6 Richard Rd., Wayland, Mass.
Edward R. Cruise, '20; June 22, 1982; La Civita Ct., Stoughton, Mass.
David J. Kaplan, '20; September 9, 1982; 3576 South Ocean Dsr., South Palm Beach, Fla.
Larcom Randall, '21; August 23, 1982; Villa #52, 5860 Midnight Pass Rd., Sarasota, Fla.
Carl B. Braestrup, '22; August 8, 1982; 9891 Gulf Shore Dr., Vanderbuilt Beach, Naples, Fla.
Theodore Riegel, '22; April 19, 1982; 6152 North Verde Trail, Apt. D123, Boca Raton, Fla.
Alfred J. Schneider, '23; July 1980; 105 Woodbine, Ave., Merchantville, N.J.
Helen F. Whitaker, '23; September 14, 1982; 1285 Gulf Shore Blvd. N. #20, Naples, Fla.
Gertrude G. Harris, '24; June 19, 1982; Wells, Vt.
Theodore H. Butler, '25; June 15, 1982; 48 North St., Grafton, Mass.
Arthur B.S. Foale, '25; October 16, 1978; 4110 Los Coches Way, Sacramento, Calif.
Charles G. Roberts, '25; February 28, 1982; 5 Cleevelands Ave., Cheltenham, England.
Vitaly M. Sakouta, '28; June 25, 1982; 629 55th St., West Palm Beach, Fla.
Frank Buckle, '29; April 24, 1982; PO Box 392, Green Valley, Ariz.
Donald W. Diefendorf, '30; August 4, 1982; Hedge Lane Rd. 2, Cazenovia, N.Y.
John T.R. Nickerson, '32; August 16, 1982; PO Box 935, Onset, Mass.
Albert L. Schulerud, '34; July 10, 1982; 32 Carteret Pl., Nutley, N.J.
Tzu Ching Huang, '35; July 23, 1982.
George M. Levy, '37; September 4, 1982; 808 Dedham St., Newton Center, Mass.
Charles E. Ryan, '37; July 28, 1982; 421 Concord Rd., Bedford, Mass.
Charles T. Goddard, '40; May 21, 1982; Cherry Hill Farm, Pleasant Valley, Penn.
Stanley P. Hurley, '40; June 20, 1982; Story Rd., Gloucester, Mass.
Ernest L. Little, Jr., '41; July 29, 1982; 2116 The Highway, Wilmington, Del.
Richard H. Sugatt, '41; September 18, 1981; 68 Upper Hook Rd., Rhinebeck, N.Y.
Stephen H. Haybrook, '45; June 24, 1982; Route 28, Poland, N.Y.
William G. Hawley, '47; June 20, 1982; 28 Mill Pond Rd., Sudbury, Mass.
Milton H. Clark, '48; April 10, 1982; PO Box 2303, La Jolla, Calif.
Carl S. Mathews, '54; July 10, 1982; 7114 Murray Ln., Annandale, Va.
David R. Peters, '66; July 24, 1982; 2767 Motor Ave., Los Angeles, Calif.
Howard Appledorf, '68; September 5, 1982; 2670 SW 14 Dr., Gainesville, Fla.
John A. Lomanto, '82; June 13, 1982; 589 Merrick Rd., Rockville Centre, N.Y.

Courses

I
Civil Engineering

Thomas J. Adler, Ph.D.'76, has been promoted from assistant professor to associate professor in the Engineering Sciences Department of the Thayer School at Dartmouth College. He's been a member of the Dartmouth faculty since 1976 while at the same time working on research at the M.I.T. Center for Transportation Studies. . . . **Demetrious C. Koutsoftas,** C.E.'72, a geotechnical engineer, has been named an associate of Dames and Moore, Los Angeles, Calif. Currently he is assigned to the Hong Kong office "providing expertise during the construction of the new Hong Kong airport."

Richard E. West, S.M.'71, of Belmont, Mass., passed away on June 4, 1979; no details are available.

II
Mechanical Engineering

Gary Petaja, S.M.'71, reports, "I am currently corporate director of engineering at American Telecommunications Corp. and have two patents on telecommunications equipment." . . . **Dwight M.B. Baumann,** Sc.D.'57, professor of engineering design at Carnegie-Mellon University who is nationally known as an inventor of transportation systems and an innovator in design education, now holds the 1982 Chester F. Carlson Award by the American Society for Engineering Education. The award was in recognition of "creative talents to the design and implementation of new instructional techniques and concepts." Professor Baumann was founder of Carnegie-Mellon's Center for Entrepreneurial Development.

John E. Mayer, Jr., Sc.D.'60, manager of the Machine and Wear Department, engineering and research staff, Ford Motor Co., Dearborn, Mich., has been installed—for a two-year term—as a member of the Board of Directors of the Society of Manufacturing Engineers. . . . **Robert Harvey,** S.M.'47, is currently president and chairman of the board of the Thoratec Laboratories Corp., a biomedical products company specializing in devices based on physiological sensors and special biomaterials for cardiopulmonary and critical care. . . . **Howard A. Leibowitz,** S.M.'63, has been named director of manufacturing engineering, Consumer Products Division, of Corning Glass Works, Corning, N.Y. He joined Corning in 1965 and since 1977 served as director—machine technology, Manufacturing and Engineering Division. . . . **Gregory C. Tocci,** S.M.'73, has been elected president of Cavanaugh Tocci Associates, Inc., Natick, Masss.

John R.V. Dickson, S.M.'40, a retired aviation ordnance officer who served with the Army Air Forces in the Pacific during World War II, passed away on April 23, 1982. He was inspector general of the Air Force Systems Command at Andrews Air Force Base when he retired from active duty in 1965, and was the recipient of the Distinguished Service Medal, two Legions of Merit, and the Air Force Commendation Medal. . . . **J.F. Rodenhauser,** S.M.'37, passed away on July 8, 1982; no details are available.

D.J. Blickwede

E. C. Roberts

III
Materials Science and Engineering

Gerald S. Meiling, Sc.D.'59, has been named director—technical products development, Research and Development Division, of Corning Glass Works. He joined Corning in 1966, and since 1978 he was manager—technical products portfolio, Research and Development. . . . **Patrick Tissier,** S.M.'79, writes that he is an engineer in the space division of the French firm of MATRA. "I participate in the development of the attitude and orbit control subsystems of the French earth observation satellite, SPOT. I am in charge of the tests of the sub system." . . . Two alumni have been installed as officers of the American Society for Metals: **Donald J. Blickwede,** Sc.D.'48, vice-president and director of research (retired) for Bethlehem Steel Corp., is vice-president of ASM for 1982-82; and **Earl C. Roberts,** Sc.D.'52, head of the Aerospace Metallurgical Laboratory for the Boeing Co. is trustee for 1982-85.

V
Chemistry

Josephus Gaston Norman, Jr., Ph.D.'72, since 1980 professor of chemistry and associate dean for research in the Graduate School and faculty member since 1972, has been named associate dean for graduate programs and research in the Graduate School of the University of Washington, Seattle. . . . **Marcia L. Coleman,** Ph.D.'73, of E.I. du Pont de Nemours & Co., Inc., Polymer Products Department, Wilmington, Del., was an author of a technical paper: "Hytrel-Polyester Elastomers" which was presented during the 121st National Meeting of the Rubber Division of the American Chemical Society. . . . **Dieter Klaubert,** Ph.D.'71, has joined Ortho Pharmaceutical Corp., Raritan, N.J., as group leader, medicinal chemistry.

Ajay K. Bose, Sc.D.'50, professor of chemistry at Stevens Institute of Technology, Hoboken, N.J., was inducted last winter as a Fellow of the Indian National Science Academy in Mysore, India. As a result of his visit to India, he will collaborate with laboratories in India on several research projects. . . . **George J. Thomas, Jr.,** Ph.D.'67, professor in the chemistry department at Southeastern Massachusetts University, has been named chairman by the National Institutes of Health of its scientific review group that screens and advises the NIH on grant applications for research in biophysics and biophysical chemistry.

Gilbert King, Ph.D.'33, a well known industrial research scientist, passed away on July 10, 1982. Dr. King had been associated with International Telemeter Corp., I.B.M., and Itek Corp. before becoming general manager and vice-president for research at Aerospace Corp., from which he retired last year. During his career he published extensive research in quantum mechanics and infrared spectroscopy. Prior to entering private industry he was lecturer at Harvard and Yale Universities and research associate at M.I.T. He was a fellow of the American Physical Society, Optical Society of America, and the New York Academy of Sciences, while also serving on the scientific advisory boards for the U.S. Army and Air Force.

Douglas G. Harvey, S.M.'53, director of the Department of Energy's Office of Industrial Programs from 1975 until his retirement in 1980, passed away on June 14, 1982. Prior to his association with the DOE, he worked for the Martin Marietta Co., Baltimore, Md., Sanders Nuclear Co., Nashua, N.H., and Hittmann Associates, Columbia, Md. . . . **William L. Walsh,** Ph.D.'33, of Ocala, Fla., passed away on June 3, 1981; no details are available.

VI
Electrical Engineering and Computer Science

Marvin Minsky, Donner Professor of Science in the department, was honored as Bendix Innovation Fellow during the fifth annual Creativity Week Symposium at the Center for Creative Leadership, Greensboro, N.C., last fall. The symposium is an international forum on applied creativity, including creativity research and its applications in increasing individual and organizational innovation; Dr. Minsky's address, entitled "Artificial Intelligence," dealt with the present and future impact of computers as resources for innovation.

Alvin W. Drake, '57, professor of systems science and engineering, is the senior author (among three members of the M.I.T. faculty) of *The American Blood Supply* (Cambridge: M.I.T. Press, 1982), a study of technical and policy issues surrounding blood banks and blood donations in the U.S. His coauthors are **Stan N. Finkelstein,** '71, associate professor of health management in the Sloan School, and **Harvey M. Sapolsky,** professor of public policy and organization in the Department of Political Sci-

Toward Leaner Transport

Deregulation will make U.S. freight transportation more efficient and therefore more profitable, but the process of changing "corporate cultures and operational priorities" will be traumatic for both transporters and their customers, says Theodore P. Heuchling, '46, vice-president of Arthur D. Little, Inc.

The increased profits will come from eliminating uneconomic traffic and capacity, correcting circuitous routings, and reducing empty backhauls, says Mr. Heuchling. For rail lines the "shake-out" period may last as long as a decade, he thinks—and may in the end result in a slight increase in ton-miles at the expense of other transport modes. Because its assets are more mobile and short-lived, the trucking industry will take care of its reorganization in perhaps five years, becoming "lean and efficient"—and even profitable, given "a reasonable level of economic activity"—by 1987.

In the meantime, deregulation and recession combine to suggest to Richard C. Norris, Sc.D.'62, that haulers concentrate on long-term contracts. Dr. Norris, a senior consultant in operations research for ADL, says this will involve concessions by both shippers and carriers: shippers will have to concentrate volume and consolidate their shipments, and carriers will have to provide the special services their customers need.

ence. . . . an unlikely interdisciplinary team. Each had his own interests in the subject, they write in their foreword—Professor Drake through operations research on blood-bank inventory control, Professor Finkelstein in innovation in medical care, and Professor Sapolsky in the history of the scientific research leading to blood preservation. The result, they write, is "an integrated view of many aspects of the blood-services complex."

Cregar Berwick, S.M.'80, assistant professor in the department at M.I.T., served as a panelist this past summer at the the Griswold Communications Center on Northwood's Midland campus, in a discussion of the many aspects of creativity. The purpose of the conference—"Agenda for Action"—"was to propose specific means to foster and encourage greater creativity in important areas of our national life—education, government, industry, and business, as well as the arts." . . . **Pat V. Costa,** S.M.'69, general manager at GCA/Precision Scientific Group, Chicago, Ill., has been elected vice-president of GCA Corp., a supplier of analytical and laboratory equipment. . . . **John M. Fluke,** S.M.'36, chairman and chief executive officer of the John Fluke Manufacturing Co., Mountlake Terrace, Mass., has taken the additional post of temporary president.

Alfred G. Ward, S.M.'40, retired naval commander of the Second Fleet, passed away on April 3, 1982. In 1961 he was named commander of the Atlantic Fleet's amphibious forces, having been assistant chief of naval operations in 1960. In 1962, he was commander of the Atlantic's Second Fleet and was chief of the naval task force that President Kennedy ordered to blockade Cuba. Until his retirement in 1968, he also was a U.S. military representative to the North Atlantic Treaty Organization in Brussels, Belgium. . . . **Aldo DeSimone,** S.M.'56, who aided in the development of the underwater navigational guidance systems for the Polaris, Poseidon, and Trident Submarine fleets, died on April 20, 1982. Most recently, he served as program manager of the Urban Mass Transporation Administration's Advanced Group Rapid Transit Systems Development Project, Washington, D.C. Prior to this he was a staff member of Draper Laboratory, Cambridge, Mass., where he was a development engineer on the Mark Zero ship's inertial navigation system. He later became program manager for Draper's Mark IV development and for the Command, Control, and Communications Center for the Deep Submergence Rescue Vehicle.

Lawrence A. Harris, Sc.D.48, a scientist at General Electric Co.'s Corporate Research and Development Center, Schenectady, N.Y., passed away on May 7, 1982. In 1955 he joined the research laboratory after teaching for several years at the Universities of Florida and Minnesota. There he developed a scheme for stable electron beams, known as the "Harris flow." He then received the American Vacuum Society's Welch Award in 1973 for the development of the first practical Auger spectroscopy system. His attention then turned to the photoelectrochemical approach for storing solar energy. His "ability to move into an area of research, recognize the problems, and find creative solutions was the hallmark of a distinguished career," said a colleague in a memorial notice.

Edward W. Kimbark, Sc.D.'33, of Portland, Ore., passed away on February 8, 1982; he had most recently served as consultant to the Bonnevile Power Authority. . . . **Serge J. Zaroodny,** S.M.'34, of Havre de Grace, Md., passed away in August 1981; no details are available.

VI-A Program

VI-A's annual West Coast picnic, hosted by Director John A. Tucker, was held in Las Palmas Park, Sunnyvale, Calif. on August 14, 1982. Some 40 current students, plus guests from Hewlett-Packard and other alumni/ae, attended this enjoyable affair. Alumni/ae attending included: **Allen J. Baum,** '74; **Thomas L. Bentley,** '73; **John F. Cooper,** '74; **Lynn (Roylance) Freret,** '72; **J. Payne Freret, Jr.,** '68; **Eric A. Slutz,** '74; **Paul E. Stoft,** '49; and **Kenneth A. Van Bree,** '71. All but John Cooper are with the Hewlett-Packard Co. John joined Dolby Laboratories, Inc., San Francisco, Calif., last December.

Also, while in the Palo Alto area, Mr. Tucker was invited to meet with **Nilo A. Lindgren,** '48, a graduate of VI-A who is co-author with Professor (Emeritus) **Karl L. Wildes,** '22, of the new centennial history of electrical engineering at M.I.T. It was a wonderful opportunity to compare notes on the past 26 years that Mr. Tucker has been associated with the department in various administrative capacities.

Flying on to Dallas, following his West Coast visit, Mr. Tucker joined **Cecil H. Green,** '23, who hosted his annual VI-A luncheon for students, managers and executives of Texas Instruments, Inc. In addition to this year's 13 VI-A students working at Dallas and Houston, the following VI-A graduates, now employed by Texas Instruments, attended: **Keith A. Blanton,** '78; **Dean R. Collins,** '58; **Robert D. Doiron,** '81; **Steven D. Krueger,** '79; **Michael W. Patrick,** '79; and Vice-President **Joseph D. Zimmerman,** '59, whose son, Dale, is currently a VI-A graduate student at Texas Instruments.

Our VI-A co-ordinator at AVCO's Everett Research Laboratory for many years, Mrs. **Donna B. (Northam) Bourgelais,** '70, recently left to become associated with Laakman Electro-optics, San Juan Capistrano, Calif. We are sorry to lose her help at AVCO, but wish her well in her new association on the West Coast.

Director Tucker recently received a letter and a package of VI-A memorabilia from **Charles T. Burke,** '23, which he thought we'd like "since you are on an historical binge." This included some old issues of *Sparks* and *VI-A News* which we're glad to have. Mr. Burke mentions he was a seminar partner of his distinguished classmate **Cecil H. Green,** '23. Mr. Burke's professional career was with the General Radio Co. (now GenRad) where he mentions having hired their current president, **William R. Thurston,** '44, and senior vice-president **Harold T. McAleer,** '52, both VI-A graduates, and two others who did their VI-A work at GenRad: **Robert G. Fulks,** '58, and **Henry P. Hall,** '51; Henry having participated in the Williams College/M.I.T. Combined Plan in addition to VI-A. Speaking about VI-A, Mr. Burke continues: "Both my own experience as a student and practicing engineer, and the men it produced for us at G.R., convinces me that it is a valuable educational experience."

Since our last article, the following visitors have registered in the VI-A guest book: **Leonard N. Evenchik,** '66, who's with Bolt Beranek & Newman, Cambridge, Mass.; **Michael A. Gennert,** '79, who returned to M.I.T. for further graduate study this fall; and **Michael Moncavage,** '82, who has joined Schlumberger, Inc., and planned to head for the Near East in October.—John A. Tucker, Director, Course VI-A, Room 38-479, M.I.T., Cambridge, MA 02139.

VII

Biology

Two deaths have been reported: **Hans Meier,** '59, of Bar Harbor, Maine, on May 14, 1981; and **Arnold F. Brodie,** '49, of Pasadena, Calif., on January 24, 1981. No details are available.

VIII

Physics

William S. Guindon, S.J., Ph.D.'38, reports, "The Jesuit School of Theology in Chicago, where I had been dean, then president for the last five years, closed its door in June 1981 for lack of finances, mostly. I enjoyed a great sabbatical, attending an educational conference in Washington—the summer of 1981—then having a two-month vacation in Mammee Bay, Jamaica, W.I. The six months, January-June 1981, I spent at Campion Hall, Oxford, England, attending lectures at the university and reading in ecumenical theology there. Next assignment is still indefinite, but it will probably combine some administrative work for the Jesuits—with ecumenical involvement—most likely in the Boston area. I am looking forward to reading 'The World According to Weisskopf,' my old dissertation director, which was awaiting me here. I was proud to see his delegation by John Paul II to head the representations of the Pontifical Academy of Sciences to President Reagan and the U.N. on the moral and technical difficulties associated with annihilative deterrence weapons."

Benjamin W. Roberts, Jr., Ph.D.'49, physicist and technical coordinator at the General Electric Corporate Research and Development Center, Schenectady, N.Y., passed away on June 15, 1981. **Rene S. Julian,** Ph.D.'47, of Bainbridge Island, Wash., passed away on April 11, 1982; no details are available. . . . **Charles A. Domenicali,** Ph.D.'49, of Philadelphia, Penn., passed away on March 23, 1982; no details are available.

X

Chemical Engineering

Michael Modell, '60, president of Modar, Inc., has been issued a patent for a waste treatment process utilizing the unusual properties of water under supercritical conditions which were the subject of his research as a member of the M.I.T. faculty in the 1970s. The idea to use the power of supercritical water to oxidize organic wastes, yielding carbon dioxide, high-temperature steam, and solid salts; the steam is recycled to power the system, with some surplus becoming available as power. Over the next few years, says Dr. Modell, Modar will introduce the process commercially.

Jerry McAfee, Sc.D.'40, retired chairman and

chief executive officer of the Gulf Oil Co., has been nominated a director of McDonnell Douglas Corp., St. Louis, Mo. .. . . **Marc Machbitz,** S.M.'78, writes, "I am currently working in the Standard (Oil Company) of California's Engineering Department, assigned to Chevron Shale Oil's (a wholly owned subsidiary) Clear Creek Shale Project.". . . **Edward J. Fradkin,** S.M.'46, formerly with the Halcon SD Group, Inc., has been appointed sales director at the Heyward-Robinson Co., Inc., New York City, responsible for marketing domestic engineering and construction services. . . . **George A. Dainis,** S.M.'81, is currently working as the senior process engineer of the Electronics Parts Department Plating Group at Texas Instruments, Attleboro, Mass.

Jacek Jebruch, S.M.'58, writes, "University Press of America has just published my 600-page study: *Constitutions, Elections, and Legislatures of Poland, 1493-1977*." . . . **Myron W. Belaga,** S.M.'52, has left his position as senior vice-president of A. Johnson and Co., to join the GHR Companies, Inc., Westport, Conn., as president, chief operating officer and a member of the Board of Directors.

Roger E. Drexel, Sc.D.'46, retired DuPont Co. executive who was instrumental in making the company a worldwide supplier of agrichemicals, passed away on June 29, 1982. His 38 years with DuPont included seven years as head of its Biochemicals Department; he retired in May 1982, as vice-president in charge of the Polymer Products Department. Dr. Drexel had devoted most of his career at the DuPont Co. to agricultural research and development, including the discovery and commercialization of many important chemicals and herbicides for crop protection. Among his many affiliations, he was a member of the Board of Directors of the University City Science Center, the Pharmacuetical Manufacturers Association, the National Agricultural Chemicals Association, the Farm Foundation, and the Society of the Plastics Industry.

XI

Urban Studies and Planning

Donald A. Schon, Ford Professor of Urban Studies and Education in the department, is the author of *The Reflective Practitioner* (New York: Basic Books, 1982), an analysis of those aspects of thought and work which distinguish the professional approach to problems. The essence of a professional's claim to fame, says Dr. Schon, is a kind of "reflection in action"—the ability to do informal improvisations so that general knowledge becomes appropriate to specific problems.

Professor **Bennett Harrision** of M.I.T. is co-author, with Professor Barry Bluestone of Boston College, of *The Deindustrialization of America* (New York: Basic Books, 1982), proposing a controversial thesis that U.S. corporations have been "deindustrializing" the country by pulling capital out of the nation's basic industries and turning to diversification and foreign investment. Professors Bluestone and Harrison urge a new strategy which they call "reindustrialization with a human face"—setting limits on the free movement of capital, increasing public investment, and involving workers in the running of the enterprises in which they work.

Dietrich J. Garbrecht, M.C.P.'70, is author of *Gehen: Ein Pladoyer fur das Leben in der Stadt* (Basel, Switzerland: Beltz Verlag, 1981), an essay in book form on the virtues—practical and aesthetic—of walking as an efficient method of modern urban transportation and a palliative for the pressures of modern urban life.

Jonathan Richmond, S.M.'81, has mounted a powerful verbal attack on the proposal by the American High Speed Rail Corp. for "bullet trains" service between Los Angeles and San Diego. It's "a scheme," he says, "that is shrouded in mystery, unprecedented and untested by the slightest analysis, and as sound as a dime in a Las Vegas fruit machine." The idea is clearly patterned after the Japanese "bullet trains." But the circumstances are different, says Mr. Richmond, who is a transportation planner for the Southern California Association of Governments in Los Angeles. Japanese "bullet trains" succeed because they serve densely-populated corridors with concentrated end points. In contrast, the area between Los Angeles and San Diego has fewer people—and they're spread widely across the landscape; many would be able to drive to their destinations, as they do now, as quickly as to a station on the proposed new railroad. Mr. Richmond is no friend of more conventional railroad passenger service, either. "There's a great deal of irrational public support for Amtrak," he writes; "people don't want to ride the trains, but they want them to be there."

Leading Executive Producer

More of America's top business executives—presidents, vice-presidents, and directors—have graduate degrees than ever before, and more of these have come from M.I.T. than ever before, according to 1982 figures from Standard and Poor's marketing subsidiary, Compmark.

In all, nearly 24,000 executives surveyed by Compmark this year have graduate degrees—compared with 52,400 with undergraduate degrees. Some 566 of those graduate degrees are from M.I.T.'s Sloan School, making it eighth in the ranks of degree grantors. Harvard is first, with 3,849 graduate-degree-holders in the top ranks of American corporate management; N.Y.U. (1,370) and Columbia (1,223) are second and third.

Though M.I.T. does not appear in the top 12 schools giving undergraduate degrees to executives, the Institute is 11th in awarding all degrees to today's top executives; that's up from 12th in the same survey in 1980.

XII

Earth and Planetary Sciences

Lloyd Breslau, Ph.D.'57, has left his post as technical director of the Coast Guard Research and Development Center to take a job with the Army Corps of Engineers in Hanover, N.H., as technical director of the U.S. Army Cold Regions Research and Engineering Laboratory. The specialized research facility, which concentrates on all aspects of land and sea in the Arctic and other cold regions, currently employs 300 people.

XIII

Ocean Engineering

Luis E. Siebert, S.M.'79, writes, "Right now I am the head of the Department of Docks and Marine Structure at ASMAR Shipbuilding, Talcahuano, Chile. Recently, I attended and participated in a conference of IPIN (Pan American Institute of Naval Engineering) in Vina Del Mar, Chile . . . (which included) important guests involved in the ocean engineering and marine engineering field." . . . **Aniceto Cruz Santos,** S.M.'42, reports that he is a retired rear admiral (naval constructor) in the Brazilian Navy. He is presently director and president of Ishikawajima Do Brasil Estaleiros SA, Ishibras, Rio de Janeiro, Brazil, and a member of the American Bureau of Shipping Technical Committee, New York. . . . **Commander Jay M. Cohen,** U.S.N., S.M.'72, formerly the ship's executive officer, has become the commander of the submarine George Washington Carver. He has previously served aboard the submarines Nathanael Greene and Nathan Hale.. . . **Lieutenant Commander Frederick R. Hamberlandt,** U.S.N., S.M.'78, reports, "Recently completed a tour as a nuclear ship superintendent and presently in process of relieving as submarine type desk officer at Charleston Naval Shipyard, Charleston, S.C.

Loy W.A. Renshaw, S.M.'46, retired Coast Guard captain, who was an engineering professor at the Coast Guard Academy for four years prior to his retirement as commanding officer of the Coast Guard Yard in Baltimore, Md., in 1972, passed away on February 11, 1982, in Boca Raton, Fla. He was a member of the Society of Naval Architects and the Retired Officers Association, and was an executive director of the Coast Guard Academy Foundation in the Florida Coast Guard District.

XIV

Economics

Are Massachusetts corporations overtaxed? It's been a popular theory, fueling much of the political effort which resulted two years ago in the tax-limiting measure called "Proposition 2 1/2." Now a new view from **William C. Wheaton,** associate professor of economics at M.I.T., in an interview with Bruce A. Mohl of the *Boston Globe*: the real question is what share of state expenses is assessed on industry, not the absolute level of business taxes, he said. For example, though Massachusetts companies pay higher taxes, Louisiana companies provide a larger share of the state's total tax income. By this measure, Massachusetts was—as of 1977, when Professor Wheaton's data were taken—the ninth among the 50 states in industrial tax rates.

Scott E. Pardee, Ph.D.'62, the company's executive vice-president, has been elected a director of Discount Corp. of New York City, New York, a dealer in U.S. Treasury and agencies issues, certificates of deposits, bankers acceptances and repurchase agreements. . . . **George W. Shuster,** S.M.'69, group vice-president of Cranston Print Works Co., Cranston, R.I., has been elected to its board.

XV

Management

Most people expect a new company to lose money for it several years, while it brings its people and products up to speed. That's a dangerous time, says **Robert A. Swanson,** '69, president of Genentech, Inc.—not because of the outflow of money but because of the dangerous psychology it engenders. "People working there get used to losing money," he told **Paula Cronin,** S.M.'77, last fall—"it seems to be O.K." But that psychology never really took hold at Genentech. Despite the special problems of bringing the products of genetic technology to the marketplace, the company succeeded in controlling its losses, Mr. Swanson said in an interview to be published this winter in *Sloan* magazine, of which Ms. Cronin is editor. By its second year Genentech's revenues were $7.5 million, and in the second quarter of that year earnings were between one and three cents a share.

C. Lawrence Meador, S.M.'72, president of Decision Support Technology, Inc., is co-author with **Frank P. Davidson,** director of the Macroengineering Study Program at M.I.T., of *Macro-Engineering and the Future: a Management Perspective* (Boulder, Colo.: Westview Press, 1982). The thesis is that major engineering projects are a specialty of their

Ending Wars Before They Start

For every dispute that has erupted in fighting in 1982—the Falkland Islands, Iraq vs. Iran, Israel vs. the Palestinians—at least three others smoulder in the background, threatening ignition. It could happen anytime in the Western Sahara, Guyana, Kashmir, Belize, and elsewhere, says Professor Lincoln P. Bloomfield in the *Boston Globe*.

To lessen the risks, says Professor Bloomfield, world leaders should adopt six steps:

☐ President Reagan should organize "conflict-anticipation" activities in his administration, so that U.S. influence can be used before rather than after wars break out. "If no guns are firing," says Professor Bloomfield, "crisis managers seem to believe that 'nothing is happening.'"

☐ The Secretary General of the United Nations should give the U.N. Institute for Research a similar assignment: objective analyses of all unresolved territorial disputes.

☐ The diplomatic profession should "finally decide to enter the 20th century" and start using "computerized conflict-anticipation systems" such as Professor Bloomfield and his colleagues have developed at M.I.T.

☐ The U.N. Peacekeeping Committee's recommendation for "pre-war peace observation" should be dusted off and put in effect.

☐ The unused World Court should be put to work to adjudicate disputes.

☐ The "highly enlightened" arbitration clause in the Law of the Sea Treaty should be extended to apply to other fields.

"There is at least a chance that some of the 1982 wars might have been averted," says Professor Bloomfield, "if the diplomatic energy poured into crisis diplomacy after fighting had begun had instead been applied to solving problems in negotiation."

own, requiring unique techniques of management and strategies of financing which together represent a new approach to technical development.

Vincent S. Castellano, S.M.'77, writes, "For the past two years I have been an associate in the Private Finance Department, Investment Banking Division, at Goldman, Sachs, & Co. Currently specializing in secured financings (especially leasing), where the financing is structured as an investment and then marketed directly to the institutional investor market (insurance companies, pension funds, credit and finance companies, banks, etc.)" . . . **Harvey C. Berger,** S.M.'76, writes that he is a graduate of the University of San Diego School of Law (December 1981). He is currently a consultant for Marc D. Roberts and Associates, Inc., San Diego, Calif., a labor relations consulting firm specializing in agricultural labor relations. . . . **Jorge R. Peschiera,** '75, writes, "Since November 1980 I have been manager of the International Division at Banco Commercial Del Peru, in charge of all foreign currencies operations in the bank. I am also president of Datamat, a small consulting and software firm." . . . **Robert D. Hulse,** S.M.'68, has been appointed vice-president, new ventures and diversification for the Englehard Industries Division of Englehard Corp., Edison, N.J., responsible for developing new divisional business through acquistions, government sales and internal technical ventures. He was formerly vice-president and general manager of Halcon Catalyst Industries. . . . **John D. Rudolph,** S.M.'73, is now manager—engineering and manufacturing planning at Corning Glass Works' Technical Products Division.

Jackson M. Balch, '37, of Pass Christian, Miss., passed away on August 26, 1981; no details are available.

Sloan Fellows

William G. Evans, S.M.'60, president of TRW Reda Pump Division, Bartlesville, Okla., has been appointed the representative of TRW's University-Executives Program to the Sloan School of Management; the idea is to help strengthen TRW's relationship with universities critical to providing talent and technology in the 1980s. . . . **Robert L. Swain,** S.M.'71, has been selected as director of systems engineering and operations at NASA's Langley Research Center, Hampton, Va. . . . **Peter S. Hepp,** S.M.'68, formerly a group vice-president at Sun Co., Inc., has been named group vice-president at UNC Resources, Falls Church, Va., in charge of its Oil and Gas Support Group. This group includes UNC's subsidiaries engaged in ship construction and repair, supplying offshore oil production equipment and services, and exploring for and producing oil and gas. . . . **Thomas J.R. Johnson,** Ph.D.'67, writes, "Have started new computer software company. Would like to hear from other Sloan alumni, who undoubtedly did same—to share experiences." . . . **Mark B. Pearlman,** S,M.'78, has been appointed to the newly-created position of director, Market Strategy, for CBS, Inc. He works with the CBS/Broadcast Group in developing strategies to take advantage of the emerging technologies in the field. . . . **Ralph L. Hennebach,** S.M.'53, has been elected chairman and chief executive officer of ASARCO, Inc., New York City; he has been president of the company since 1971 and a director since 1964.

XVI

Aeronautics and Astronautics

Ross M. Jones, S.M.'78, writes, "I am senior engineer in the Advanced Power Systems Analysis Group at the Jet Propulsion Laboratory, Pasadena, Calif., responsible for analysis of advanced solar and nuclear space power supplies and electric propulsion systems. I am also manager of the energetics research and development program at JPL, which seeks to identify and evaluate new concepts in energy conversion, storage, and transmission for future NASA space power systems." . . . **Courtland D. Perkins,** S.M.'41, president of the National Academy of Engineering, has been elected vice-chairman of the Board of Trustees of the Mitre Corp., Bedford, Mass. . . . **Alan Bannister,** S.M.'80, received his wings as a fighter pilot in the Royal Air Force on May 14, 1982, in ceremonies held at RAF Valley (Valley Air Force Base), Anglesey, Wales. After advanced training at RAF Brawdy, Dyfed, Wales, he will be assigned to a squadron.

Abner B. Martin, S.M.'54, formerly corporate vice-president in charge of defense and aerospace operations at the Sperry Corp., New York City, has been promoted to group vice-president, responsible for the Defense and Aerospace Group. He retired from the U.S. Air Force with the rank of lieutenant general in 1979.

Robert F. Merkle, S.M.'59, of Lexington, Mass., passed away on December 14, 1981; no details are available.

XVII

Political Science

Albert H. Teich, Ph.D.'69, who is manager of science policy studies at the American Association for the Advancement of Science, is co-editor of *Science, Technology, and the Issues of the Eighties: Policy Outlook* (Boulder, Colo.: Westview Press, 1982). The book is the report by A.A.A.S. of its findings in a second five-year survey of science policy issues for the National Science Foundation. Dr. Teich was project manager for that five-year study, which is mandated by the U.S. Congress. Among the contributors: **Richard A. Rettig,** Ph.D.'67, Professor **Eugene B. Skolnikoff,** '49, and **Charles Weiner,** professor of the history of science and technology in the M.I.T. Program in Science, Technology, and Society.

J. Raymond Watson, S.M.'59, writes, "Appointed chairman of the Convention Promotion Committee for UPADI '82, the 17th Convention of the Pan American Federation of Engineering Associates, which was held August 1-2, 1982, in San Juan, Puerto Rico. Over 2,000 engineers from Argentina to Canada attended the convention and its six parallel meetings on civil engineering, costs, oceanographic engineering, energy, environment, and education."

Edwin Diamond's *Sign Off: The Last Days of Television* (M.I.T. Press, 1982) is attracting widespread interest. It's a critique of the performance of today's conventional networks set against a future which will be dominated by cable and satellite transmissions of far greater variety and offering two-way, viewer-responsive features and add-on computer capabilities. TV newsman Dan Rather calls it "sunbursts of thought about where we are and where we may be headed." Mr. Diamond is senior lecturer in the department at M.I.T.

Jeffrey A. Raffel, Ph.D.'72, associate professor of urban affairs and public policy and political sciences at the University of Delaware, has been promoted to full professor. Also at the University of Delaware, **Daniel Rich,** Ph.D.'72, in the same department, has been promoted to full professor. . . . **Richard A. Rettig,** Ph.D.'67, writes, "Beginning with the fall 1981 semester, I became professor of social science and chairman of the Department of Social Sciences at the Illinois Institute of Technology, Chicago; leaving the Rand Corp., Washington, D.C., where I had been senior social scientist from 1975 to 1981.

XVIII

Mathematics

Ralph L. Miller, Ph.D.'66, has been named to the newly created postion of vice-president—engineering and strategic planning for the Heavy Vehicles Components Operations of Rockwell International, Troy, Mich., responsible for engineering services, research and development, and strategic product planning. Dr. Miller was previously with General Motors Corp., most recently as director of facilities planning.

For the simplest, more direct solution to Rubik's

Revenge, buy a copy of **Jeffrey Adam**'s book, *How to Solve Rubik's Revenge* (Dial Press, 1982). Dr. Adams arrived at M.I.T. as an instructor in the department just a year ago, and he says Rubik's Revenge—16 cubes on each side, in contrast to the nine on the original Rubik's Cube—is "the most incredible puzzle I've ever seen." Dr. Adams is not a speed demon—it takes him eight minutes to do Rubik's Revenge. What he likes is "the mathematics of it, the patterns, and understanding it as a puzzle," he says.

Stephen M. Paneitz, PH.D.'80 reports, "This fall (on September 1), I began a visiting assistant professorship in the M.I.T. Department of Mathematics."

XIX

Meteorology

Assistant Professor **Kerry A. Emanuel,** '77, spent the summer in Denver as a participant in JAWS—the Joint Airport Weather Studies—funded by the National Science Foundation. The goal was to determine the cause and characteristics of microbursts—small, intense downdrafts found under the cloud base of developing storms. Professor Emanuel's theory relates these downdrafts, which often present unexpected problems to pilots, to the interaction of humid air from near the earth's surface with dry air at higher levels in the turbulence of midsummer storms.

Alan Robock, Ph.D.'77, has been promoted to associate professor in the Department of Meteorology at the University of Maryland, College Park. . . . **Willem van Dijk,** '58, reports, "I am teaching general meteorology to undergraduates at the Ryks Universiteit of Utrecht, The Netherlands, and am doing research on the general circulation of the atmosphere."

XXIV

Linguistics and Philosophy

Paul Horwich, associate professor of philosophy at M.I.T., is the author of *Probability and Evidence* (Cambridge University Press), appearing this fall. The publisher describes it as presenting "a unified approach to solving a number of problems in the philosophy of science . . . by emphasizing the *degree* of confidence to which we are entitled in the light of scientific evidence."

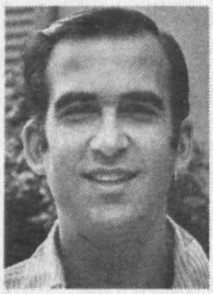
Technology and Policy Program

Lissa Martinez, has rejoined the Maritime Administration of the Department of Transportation in Washington, D.C. Her work focuses on maritime transportation of dangerous goods, waste disposal in the ocean, general ship pollution prevention, and maritime occupational health and safety. . . . **Oswaldo Cortez,** S.M.'81, is currently coordinator of technology and planning with Meneven, a Venezuelan petroleum company. . . . **John C. Stewart,** '80, is employed at Teledyne Geotech, Washington, D.C. He is working on a computer system designed to process seismic data that will be used to enforce nuclear test ban treaties. . . . **Elizabeth Mulcahy,** S.M.'79, is at the Case Western Reserve University Medical School, serving as the planning coordinator for the Office of Ambulatory Care, Planning, and Development. She is involved in a variety of projects, including the development and construction of a new building to house research projects related to cystic fibrosis and the planning of new ambulatory care centers in the inner city.

Brian Mellea, S.M.'78, is working on hazardous wastes for Clark McGlellon and Associates, Boston, Mass., a consulting firm. . . . **Johan Brag,** S.M.'80, is the assistant to the president of Data Business Vision, San Diego, Calif., a computer graphics company. His work involves the development of decision support tools utilizing graphics for management.—**Richard de Neufville,** '60. Chairman, Room 1-138, M.I.T., Cambridge, MA 02139

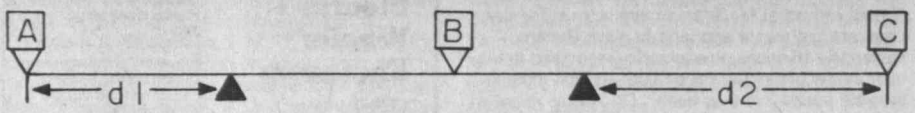
Puzzle Corner
Allan J. Gottlieb

Why Is Beer So Cheap in Mexico?



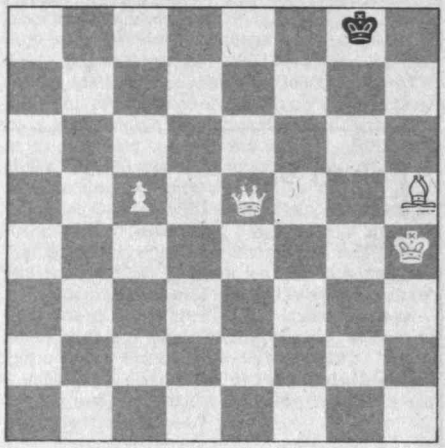
Allan J. Gottlieb, '67, is associate research professor of mathematical sciences at the Courant Institute of Mathematical Sciences of New York University; he studied mathematics at M.I.T. and Brandeis. Send problems, solutions, and comments to him at the Courant Institute, New York University, 251 Mercer St. New York, N.Y. 10012.

Two readers have commented on remarks I made in previous issues: In July I reported a story concerning Winthrop Leeds' study of Pythagorean triples. J. Meier writes that he spent many enjoyable childhood mornings doing mental arithmetic, often with Pythagorean triples. A few years ago I noted that my former Baker House softball teammate John Rudy used unknowingly to boost my ego by complaining that my throws from deep short would hurt his hand at first base. Now John writes of a more recent episode: "We were playing a softball game and somehow I was chosen to play first (they didn't know about Baker House [obviously — ed.]). I have a 19-year-old girl working for me who throws as hard as you did; last year our first baseman got a broken finger as a result of a hard throw by her. I survived."

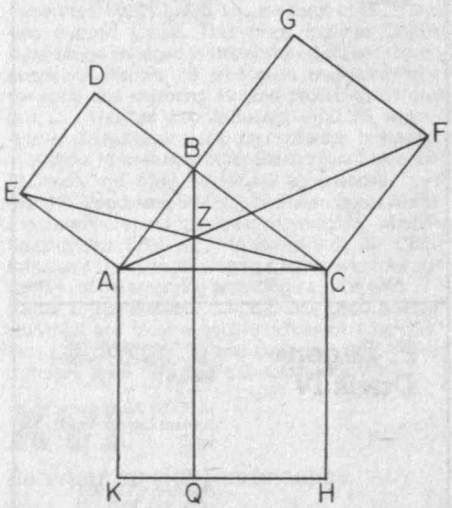


Problems

N/D 1 This month's chess problem is from Bob Kimble: given the situation shown below, White is to mate in three moves:



N/D 2 A truly classic problem from David Lukeris. In Euclid's proof of the Pythagorean theorem, the figure shown below is drawn. ABC is a right triangle; B is a right angle; ABDE, BCFG, and ACHK are the squares on the sides; and BQ is parallel to AK. The problem is to determine if the three lines EC, BQ, and AF meet at a point Z as they appear to in the drawing below.



N/D 3 Frank Rubin has a massless beam of length L supported by two stanchions at distances d1 and d2 from the ends. The beam is loaded with point masses A, B, and C at the ends and midpoint as shown at the top of this page. What is the downward force on each stanchion?

N/D 4 Alan Davis has a clock with hour, minute, and second hands initially at the 12:00 position. Will the three hands ever divide the clockface into three equal parts? If so, when?

N/D 5 Our final regular problem is from Harry Zaremba. Six different numbers are selected arbitrarily from eight positive consecutive integers. The resulting selection includes the smallest and largest of the eight numbers and can be separated into three pairs of numbers, each of which contains consecutive numbers. The sum of the six integers is three times a number N, and the sum of their cubes equals the cube of N. Find N and each of the integers selected.

Speed Department

SD 1 Steve Chilton has a question about this story. At a town on the Mexican-American border during the last century a very peculiar monetary situation arose. In Mexico a U.S. dollar was worth 90 Mexican cents, while in the US a Mexican dollar was worth 90 U.S. cents. One morning a cowboy stopped in a U.S. bar and bought a 10-cent (U.S.) beer. He paid a U.S. dollar and received a Mexican dollar in return. He then went to a Mexican bar and bought a 10-cent (Mexican) beer. He paid with the Mexican dollar he previously received and received a U.S. dollar in return. After a full day of drinking he returned home with a U.S. dollar and a hangover. Who paid for the beer?

SD 2 A geometry quicky from L. Steffens. Given eight equal cubes assembled to form a $2 \times 2 \times 2$ cube, how many paths are there from a small cube to the one diagonally opposite, defining a path as a set of cubes through which a straight line can be drawn?

Solutions

JUL 1 You wish to maximize your chances in playing this nine-card suit:
Dummy: A K 10 x
Declarer: x x x x x
You play the A from the Dummy, and an honor falls on your right. It is well known in bridge circles that the odds are now nearly 2:1 in favor of finessing West for the other honor (Rule of Restricted Choice), provided that East is known to play either the Q or J at random from a doubleton Q-J holding. The problem is to consider what happens as the combined holding shrinks from nine cards to five while still maintaining the two honors (the limiting case is A K 10 in Dummy) and calculate the exact odds for the finesse in each case (nine cards, eight, etc.).

Matthew Fountain sent us the following solution: When Declarer and Dummy combined hold N cards

of the suit, the odds in favor of finessing West are:

N	9	8	7	6	5
Odds	11/6	5/3	3/2	4/3	7/6

The "fall" of the honor implies a forced play. East started holding either one or two honors and no other cards of the suit. East and West combined started with 13 − N cards of the suit, and 26 − (13 − N) = 13 + N cards of other suits. The finesse against West succeeds when East has started with a singleton. The odds in favor of finessing West are (number of East hands with the singleton honor)/(number of East hands with the doubleton honor). The number of possible East hands with singleton honor is (number of ways of taking 1 honor from 2 honors)(number of ways of taking 12 cards from 13 + N cards) = 2(13 + N)!/12!(1 + N)!. The number of possible East hands with doubleton honors is (number of ways of taking 2 honors from 2 honors) (number of ways of taking 11 cards from 13 + N cards) = 1(13 + N)!/11!(2 + N)!. The odds in favor of finessing West are 2(13 + N)!/12!(1 + N)!/(13 + N)!/11!(2 + N)! = (2 + N)/6.

The proposer, Douglas Van Patter, believes that for N = 9 the correct answer is 15:6.

JUL 2 A rocket containing 60 gallons of fuel approaches the moon (gravity is 5 ft./sec./sec.) tail-first with an initial velocity of 50 ft./sec. when at an altitude of 500 ft. Each second thereafter an integral number of gallons of fuel may be burnt, causing an upward acceleration of x ft./sec./sec., where x = 2f − 5. Find the sequence of one-second fuel burns that maximizes the maximum f while yielding a soft landing.

Harry Zaremba responded with a fine analysis. The maximum rate at which fuel can be burned to achieve a soft landing at zero velocity is f = 30 gal./sec. The descent would be composed of four stages of motion—two of free fall alternated with two one-second engine burns. The final velocity and distance travelled at the end of each stage of motion are presented in the analysis below. Positive values of distance, velocity, and acceleration are assumed to be in the direction toward the moon's surface, and the expression for x is presumed to be the net upward acceleration during an engine burn.

Free fall—first stage:

$v_1 = 50 + 5t_1$

$d_1 = 50t_1 + 5/2(t_1^2)$

Engine burn—second stage:

$v_2 = (50 + 5t_1) - (2f - 5)t_2 = 5t_1 - 5$

in which f = 30 and $t_2 = 1$ sec.

$d_2 = (50 + 5t_1)t_2 - \frac{1}{2}(2f - 5)t_2^2 = 5t_1 + 22.5$

Free fall—third stage:

To assure a zero velocity at the end of the fourth stage for a soft landing, the final velocity at the end of the third stage must equal (2f − 5), or $v_3 = 2 \cdot 30 - 5 = 55$ ft./sec. Thus,

$v_3 = 55 = (5t_1 - 5) + 5t_3$,

from which $t_1 + t_3 = 12$. (1)

$d_3 = (5t_1 - 5)t_3 + 5/2(t_3^2)$.

Engine burn—fourth stage:

$v_4 = 55 - (2f - 5)t_4 = 55 - (60 - 5) = 0$, where $t_4 = 1$ sec.

$d_4 = 55t_4 - \frac{1}{2}(2f - 5)t_4^2 = 55 - 27.5 = 27.5$ ft.

After equating the sum of distances d_1 through d_4 to the initial altitude of 500 ft. and substituting $t_3 = 12 - t_1$ from equation (1) in the third stage, the time duration t_1 for the first stage will be $t_1 = 2.5$ sec. Therefore, $t_3 = 9.5$ sec., and the total time of descent will be

$T = t_1 + t_3 + 2 = 14$ sec.

The distances travelled during each stage will be $d_1 = 140.625$ ft.; $d_2 = 35$ ft.; $d_3 = 296.875$ ft.; and $d_4 = 27.5$ ft.

Also solved by Matthew Fountain and the proposer, Roy Sinclair.

JUL 3 Watchmakers all over the world display a symmetrical watch face in which the hands are set at 8:18. The problem is to test the idea that this watch-face division goes back to the "Golden Mean" of the Greeks, in which the most esthetically pleasing division of space was believed to be that in which the larger part occupied $[(\sqrt{5} - 1)/2]$, or approximately 72 percent, of the total area. Is there an arrangement of the hands near 8:18 that is both symmetrical and in accord with the Golden Mean? If not, what is the

time at the nearest symmetrical point and at the Golden Mean point?

John Prussing submitted the following solution. There is no arrangement of the hands that is both symmetrical about the vertical axis and divides the clock face exactly according to the golden mean. It is easy to show, using the fact that the hour hand moves at a constant rate of 30°/hr. and the minute hands moves at 360°/hr that there are 12 times at which the hands are symmetrical. The times (in units of hours past 12:00) are given by 12n/13, where n = 1, 2, . . ., 12. Of these times 8:18:28 and 3:41:32 come closest to dividing the clock face according to the golden mean

$G = (\sqrt{5} - 1)/2 \sim 0.618$.

For both of these times the fractional area bounded by the hands is 0.615. There are 22 unique arrangements of the hands that divide the clock face according to the Golden Mean. These times are given by $12(n - G)/11$ and $12(n + G - 1)/11$, where $n = 1, 2, \ldots, 11$. Of these, the times closest to the times of symmetry are 8:18:38 and 3:41:22. These differ from the symmetry times by only 10 seconds!

Also solved by Michael Jung, Winslow Hartford, Emmet Duffy, David Evans, Bruce Garetz, Frank Carbin, Steve Feldman, Dennis Sandow, Harry Zaremba, and Matthew Fountain. Several of the responders noted that the area is 62 percent, not 72 percent.

JUL 4 Find a rational number (other than 41/12) such that its square, when increased by 5, remains a square.

Judith Longyear notes that whenever
$(a/b)^2 - N = (c/b)^2$, and
$(a/b)^2 + N = (d/b)^2$, then for
$a' = Nb^2d^2 + a^2c^2$
$b' = 2abcd$
$c' = Nb^2d^2 - a^2c^2 = 2Na^2b^2 - c^2d^2$
$d' = 2Na^2b^2 + c^2d^2$, we also have
$(a'/b')^2 - N = (c'/b')^2$, and
$(a'/b')^2 + N = (d'/b')^2$.
Thus from one solution infinitely many others follow. Professor Longyear then proceeds to show that these are the only solutions. Her proof is available from the editor.

Daniel Grayson recognized that the equations
$a^2 + 5 = b^2 = c^2 - 5$
describe an elliptic curve. By applying techniques from elliptic function theory, he was also able to show that infinitely many solutions occur (details available from the editor).

John Wrench included with his solution several references to the literature. Apparently this problem was considered and partially solved by Fibonacci more than 760 years ago. Mr. Wrench recommends that interested readers consult Uspensky and Heaslet, *Elementary Number Theory*, p. 427; Dickson, *History of the Theory of Numbers*, pp. 459-472; and Sierpinski, *Elementary Theory of Numbers*, pp. 63-67. The simplest solution after 41/12 is 3344161/1494696.

Also solved by Matthew Fountain, John Prussing, Charles Sutton, David Evans, Winslow Hartford, and the proposer, Smith Turner.

JUL 5 Suppose that some new type of photographers' light bulbs undergoing a life-test for one week burned out as follows:
Sunday: ½ of the bulbs + ½ of a bulb,
Monday: ⅓ of the bulbs left + ⅓ of a bulb,
Tuesday: ¼ of the bulbs left + ¼ of a bulb, and so on progressively until
Saturday: ⅛ of the bulbs left + ⅛ of a bulb.
Assuming that there is only one filament in each bulb, which is the least number of bulbs that could have been left when the test ended? If the fractions had progressed in reverse order (starting with ⅛ of the bulbs + ⅛ of a bulb on Sunday), would the final result have been the same? Why?

The following solution is from Emmet Duffy.
Let the number of bulbs under test be A, where A and all subsequent letters B through G are integers. Then A/2 + 1/2 is the first subtraction.

Let A/2 + 1/2 = B; then
$A = 2B - 1$ (1)
less $B - 1/2 + 1/2$
$B - 1$
less $B/3 - 1/3 + 1/3$
Let B = 3C; then (2)
$B - 1 = 3C - 1$
less $C - 1/3 + 1/3$
$2C - 1$
less $2C/4 - 1/4 + 1/4$
Let C = 2D, then (3)
$2C - 1 = 4D - 1$
less $D - 1/4 + 1/4$
$3D - 1$
less $3D/5 - 1/5 + 1/5$
Let D = 5E; then (4)
$3D - 1 = 15E - 1$
less $3E - 1/5 + 1/5$
$12E - 1$
less $2E - 1/6 + 1/6$
$10E - 1$
less $10E/7 - 1/7 + 1/7$
Let E = 7F, then (5)
$10E - 1 = 70F - 1$
less $10F - 1/7 + 1/7$
$60F - 1$
less $8\frac{1}{2}F - 1/8 + 1/8$
Let F = 2G, then (6)
$60F - 1 = 120G - 1$
less $15G - 1/8 + 1/8$
$105G - 1$

Then from equations (6) through (1), $A = 840G - 1$. The minimum positive remainder occurs when G = 1 and is 104 with 839 at the start of the test, or 840 − 1. As 840 is the least common multiple of numbers 2 to 8, subtracting one half plus one half of a bulb is the same as multiplying 840 by 1/2 and then subtracting 1. The total subtraction will then result in:
$840\,(1/2 \times 2/3 \times 3/4 \times 4/5 \times 5/6 \times 6/7 \times 7/8) - 1 = (840 \times 1/8) - 1 = 104$.

If the order of subtraction is reversed the result will be:
$840\,(7/8 \times 6/7 \times 5/6 \times 4/5 \times 3/4 \times 2/3 \times 1/2) - 1 = 104$.
Any order of subtraction will give the same remainder, 104, but some orders will not result in an integer for a subtraction. It is interesting to note that if the problem had only been the reversed order of subtraction, starting with 1/8 of the bulbs plus 1/8 of a bulb, the answer would be 7 bulbs under test and none remaining at the end of the test.

Also solved by Harry Zaremba, Michael Jung, Dennis Sandow, Bruce Garetz, Judith Longyear, Matthew Fountain, David Evans, Winslow Hartford, and John Prussing.

Better Late Than Never

1981 OCT 1 Harry Zaremba was able to obtain an exact solution (we previously had only upper and lower bounds—see the July issue). His detailed analysis, available from the editor, shows that the volume is 0.42215775 cubic units.

N/D 2 A. Singer has responded.

1982 FEB 2 A. Singer and Alan Feldman have responded.

M/A 1 John Rutherford has responded.

M/A 3 Irving Hopkins feels that no proof was given that the circumscribed polygon has the maximum area.

M/A 5 William McGuinness has responded.

M/J 1 Everett Leroy and A. Singer have responded.

M/J 4 A. Singer has responded.

JUL SD 1 David Evans and Stephen Kliment note that the answer is 9567 + 1085 = 10652.

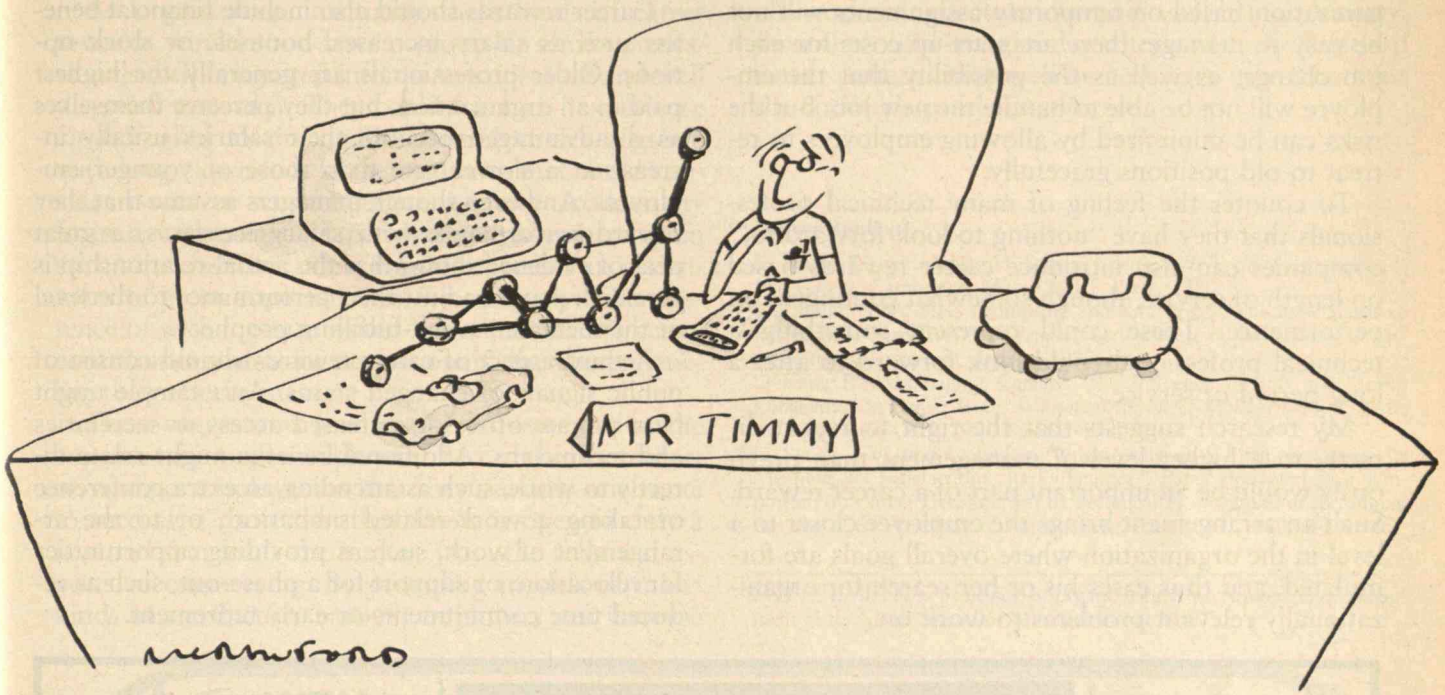
JUL SD 2 John Prussing notes that the correct solution is u = 0.684746, v = 0.816541. The alternating sequence given in July is caused by the iteration algorithm used—namely successive approximations. The algorithm does not converge but oscillates between two values v1 and v2 that satisfy cos(v1) = arctan (v2) and cos(v2) = arctan(v1). An analogy is the linear problem u = v, v = 1 − u. The solution is u = v = 1/2, but a successive approximation algorithm will oscillate between any initial value v1 and the value v2 = 1 − v1.

Proposers' Solutions to Speed Problems

SD 1 The people whose money was devalued when they crossed the border with it. After all, how did those U.S. dollars get in the Mexican bar's till?

SD 2 13 paths.

If promoted too quickly, engineers have nothing to look forward to and can become discouraged.



veloper is able to save face. But the systems engineer gets credit from management for this effort only if he follows the career scenario. Here he first turns to his manager, who then contacts the developer's manager, who, in turn, deals with the engineer. The process takes longer so the customer is less satisfied, and the relationship between developer and systems engineer becomes strained, adding to any problem of coordination they may already have. The work suffers, but the career of the systems engineer is advanced.

Professionals vary in their response to this work-career dilemma. Some, such as the puzzle-oriented engineer, are clearly work-oriented. Others know they want to advance in management and will do what is necessary to achieve that goal. And some—perhaps a large group, particularly younger employees—are ambivalent. Each group requires a different resolution of this contradiction. Individuals whose efforts center primarily on technical work—who are really the R&D lab's greatest resource—need alternative forms of recognition to keep them effective. But those trying to rise in the hierarchy are caught in another dilemma. If promoted too quickly at the beginning of their careers, these workers run the risk of future stagnation. It might be better to reverse the usual pattern and slow down promotions of younger professionals while accelerating those of career-oriented older employees. Workers who are ambivalent should be allowed to try out management without making a long-term commitment—to test themselves and demystify the managerial job.

Indeed, awarding temporary managerial assignments may make sense for all groups. Supervisory posts in the R&D lab could be regarded as job assignments for a specifc project or time period rather than a reward for good performance. If supervisory positions represent a specific set of duties rather than status and recognition, the contradiction between career and work in the R&D lab will lessen.

Career Rewards

After discussing these contradictions with representatives of a wide variety of technical organizations, I found that the problems are widespread. What can be done, then, to better manage technical professionals?

I have already touched upon one possibility: temporary assignments. Such assignments can include managerial work, new kinds of tasks, or different phases of the R&D process (for example, development instead of research, or production rather than development). New assignments help relieve stagnation, give recognition, and allow people to continue to test their skills in different work situations. An or-

The apparent shortage of technical personnel may result as much from the low productivity of older engineers as from a lack of new ones.

ganization based on temporary assignments will not be easy to manage: there are start-up costs for each job change, as well as the possibility that the employee will not be able to handle the new job. But the risks can be minimized by allowing employees to retreat to old positions gracefully.

To counter the feeling of many technical professionals that they have "nothing to look forward to," companies can also introduce career rewards based on length of service, though somewhat contingent on performance. These could represent something a technical professional could look forward to after a long period of service.

My research suggests that the right to report directly to a higher level of management than previously would be an important part of a career reward. Such an arrangement brings the employee closer to a level in the organization where overall goals are formulated, and thus eases his or her search for organizationally relevant problems to work on.

Career rewards should also include financial benefits such as salary increases, bonuses, or stock options. Older professionals are generally the highest paid in an organization, but they perceive themselves as disadvantaged because their salaries usually increase at a slower rate than those of younger employees. And even though managers assume that they reward performance with salary increases, a great deal of evidence shows that the actual relationship is reversed: people adjust their performance to the level of the increase—a self-fulfilling prophecy.

A third aspect of career rewards should consist of public signals of changed status. An example might be a private office or increased access to secretaries and technicians. Additional benefits might relate directly to work, such as attending an extra conference or taking a work-related sabbatical; or to the arrangement of work, such as providing opportunities for relocation; or support for a phase-out, such as reduced time commitments or early retirement.

What was important to these highly committed but troubled engineers was to be involved in the solution of technical puzzles.

An organization instituting these kinds of career rewards would soon have a group of senior professionals well integrated into the organization and well disposed toward it. They could form an "experience circle," akin to the quality-control circle: a group with long experience in the company that could consider issues of work effectiveness and productivity from a wide range of perspectives. Membership in such an experience circle would represent an assignment of great importance to the company. The existence of such a group would underline the distinctive contributions of older professionals, thereby enhancing their effectiveness.

These suggestions need not be implemented at the expense of younger employees. Part of the discomfort of younger employees is that they see only one route to success, a route that they know is open to only a few and that leads them away from the technical aspects of engineering. By providing models of many kinds of satisfactory careers, employers can increase all workers' effectiveness and well-being. Variety, flexibility, and imaginative alternatives to standard career patterns may well be necessary ingredients for the country's productive future.

Further Reading

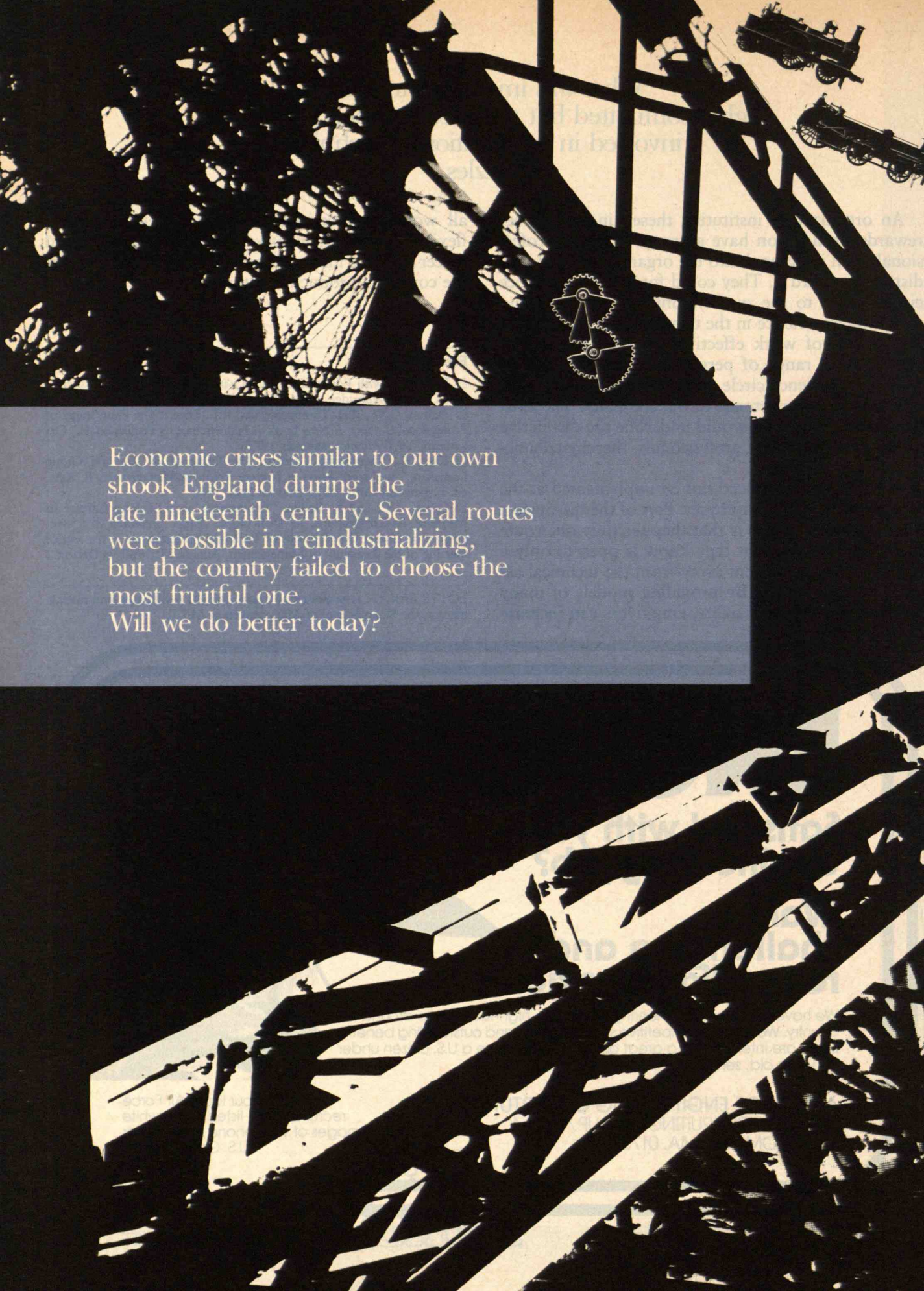
☐ Bailyn, L., with Edgar H. Schein, *Living with Technology: Issues at Mid-Career*. Cambridge, Mass.: M.I.T. Press, 1980.

☐ Dalton, G.W., P.H. Thompson, and R.L. Price, "The Four Stages of Professional Careers: A New Look at Performance by Professionals." *Organizational Dynamics*, summer 1977.

☐ Katz, R., "Managing Careers: The Influence of Job and Group Longevity." In *Career Issues in Human Resource Management*, R. Katz, ed. Englewood Cliffs, N.J.: Prentice-Hall, 1982.

☐ Lynch, J.T., and L. Bailyn, "Engineering as a Lifelong Career: Its Meaning, Its Satisfactions, Its Difficulties." Paper presented in a symposium on Career Development of Technical Professionals at the annual meeting of the Academy of Management, August 13, 1980, in Detroit.

LOTTE BAILYN is professor of organizational psychology and management at the Sloan School of Management at M.I.T.



Economic crises similar to our own shook England during the late nineteenth century. Several routes were possible in reindustrializing, but the country failed to choose the most fruitful one.
Will we do better today?

Reindustrialization Past and Present

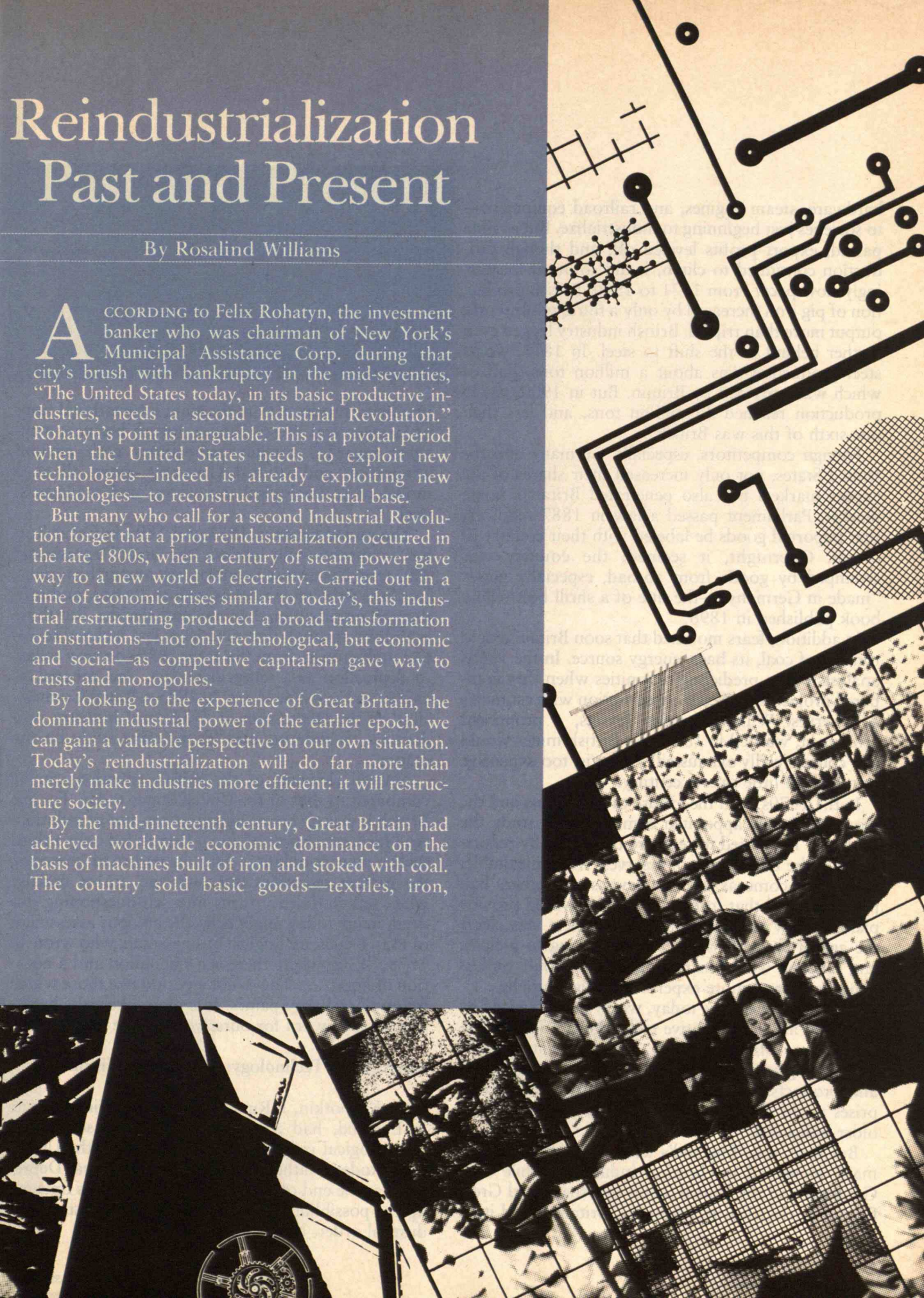
By Rosalind Williams

ACCORDING to Felix Rohatyn, the investment banker who was chairman of New York's Municipal Assistance Corp. during that city's brush with bankruptcy in the mid-seventies, "The United States today, in its basic productive industries, needs a second Industrial Revolution." Rohatyn's point is inarguable. This is a pivotal period when the United States needs to exploit new technologies—indeed is already exploiting new technologies—to reconstruct its industrial base.

But many who call for a second Industrial Revolution forget that a prior reindustrialization occurred in the late 1800s, when a century of steam power gave way to a new world of electricity. Carried out in a time of economic crises similar to today's, this industrial restructuring produced a broad transformation of institutions—not only technological, but economic and social—as competitive capitalism gave way to trusts and monopolies.

By looking to the experience of Great Britain, the dominant industrial power of the earlier epoch, we can gain a valuable perspective on our own situation. Today's reindustrialization will do far more than merely make industries more efficient: it will restructure society.

By the mid-nineteenth century, Great Britain had achieved worldwide economic dominance on the basis of machines built of iron and stoked with coal. The country sold basic goods—textiles, iron,



hardware, steam engines, and railroad equipment—to societies just beginning to industrialize. But as time passed, export profits leveled off, and though production continued to climb, it did so at an increasingly slow pace. From 1871 to 1900, British production of pig iron increased by only a third, while world output more than tripled. British industry lagged even further behind in the shift to steel. In 1871, world steel production was about a million tons, half of which was provided by Britain. But in 1900, world production reached 33 million tons, and less than one-sixth of this was British.

Foreign competitors, especially Germany and the United States, not only increased their shares of the export markets but also penetrated Britain's home market. Parliament passed a law in 1887 requiring that imported goods be labeled with their country of origin. Overnight, it seemed, the country was swamped by goods from abroad, especially goods "made in Germany"—the title of a shrill best-selling book published in 1896.

In addition, fears mounted that soon Britain would run out of coal, its basic energy source. In the 1860s analysts began predicting calamities when they compared projections of coal consumption with estimates of reserves. William Stanley Jevons, a prominent economist, warned in 1866 that British mines would be "commercially exhausted"—that is, too expensive to mine—in little over a century.

In the 1870s both the House of Commons and the House of Lords appointed committees to study the problem. They tried to reassure the public by reporting that the exhaustion of reserves, while inevitable, would not come as soon as Jevons and others had predicted, and that foreign coal fields would provide plentiful new supplies. Still, the prospect was clear: the age of cheap fossil fuel was drawing to a close, and England would increasingly have to rely on less dependable and more expensive foreign supplies.

But in that epoch as today, worry was balanced by optimism about innovative technologies. The chemical industry offered promise, and electricity seemed especially glamorous as a source of new techniques and products. The British believed that such enterprises might compensate for lagging growth rates in older industries.

But here, too, England's leadership faltered. Germany pioneered in chemical industries, while both Germany and the United States overshadowed Great Britain in electrical technologies. Britain found itself

Overnight, it seemed, England was swamped by goods from abroad, especially goods "made in Germany."

importing products from the giant international firms of Siemens and Westinghouse. British business managers regarded foreign competitors with envious admiration and studied Germany above all as a model of technological innovation and managerial skill.

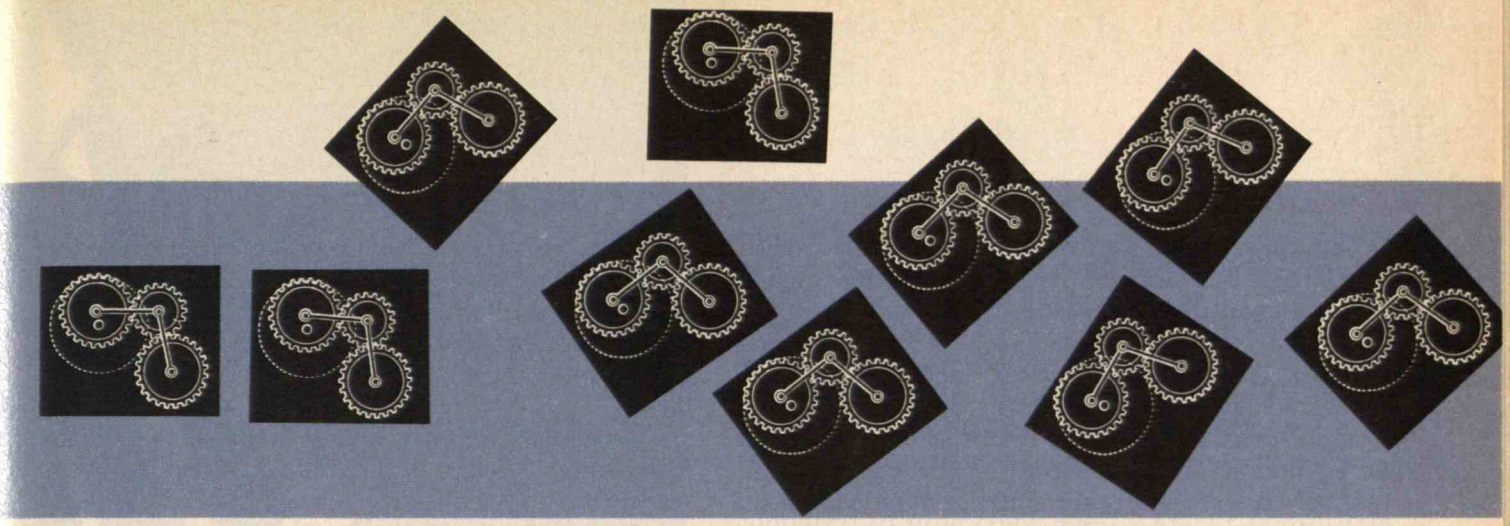
The period between 1873 and 1896 in Great Britain is conventionally labeled "the Great Depression." This term has aroused controversy among historians, for there were recoveries as well as slumps, and production never suffered an absolute decline. But those who lived through that time were less inclined to detect ambiguities: from the early 1880s on they talked of depression as a self-evident fact, and debated its causes and possible cures. In 1885 a Royal Commission on the Depression of Trade and Industry produced a meandering and inconclusive study on the matter.

Not all elements of the British situation can be compared to that of the United States today. For the British it was an era of falling prices, not of inflation. And far from exporting food, Britain fed only a third of her own population. Still, in its broad contours, the picture resembles our own: an era of malaise when self-confidence turns into self-questioning. Indeed, many today might echo the anxious assessment of H.L. Beales, an English businessman, who wrote in 1878, "Everywhere there is a stagnation and a negation of hope. . . . This is not a period like those which followed ordinary panics. It is more likely the beginning of a new era for ourselves and the world."

Appropriate Technology: A Victorian Vision

Peter Kropotkin, a Russian nobleman living in exile in England, had a far more optimistic social and technological vision—one still relevant to the United States today. Rather than regarding the Great Depression as the end of British glory, he saw it as opening up the possiblility for a more humane and stable industrial order, based on cooperative labor.

ILLUSTRATION: WATZMAN/HEITZMANN ASSOCIATES



Kropotkin, trained in mathematics, science, and engineering in St. Petersburg, served with a regiment in Siberia—the "wild East" of czarist Russia—and later organized geological and biological expeditions there. When he returned from Siberia in 1867, he joined the staff of the university in St. Petersburg and became secretary to the physical geography section of the Russian Geographical Society.

Like an Enlightenment *philosophe*, Kropotkin never doubted that science and technology were powerful instruments in human liberation. However, his experiences with the czarist court and military hierarchy convinced him that centralized bureaucracies are unjust and inefficient. He contrasted them with the self-governing peasant councils, *mirs*, he had seen operating effectively on his family's estate, and also with the Siberian pioneers who formed their own ad hoc associations to overcome the obstacles of that rugged territory. Kropotkin concluded that social organization should be based on self-managing local groups. Only then could science and technology lead to general human improvement. These political beliefs eventually led to Kropotkin's arrest and imprisonment in the dreaded fortress of Peter and Paul, but after a daring escape and exile in Switzerland and France, he finally settled in England in 1887.

In his book *Fields, Factories, and Workshops*, published in 1898, Kropotkin proposed that the underlying cause of the Great Depression was not technological but ideological. The basic error was to assume that an international division of labor was inevitable and wise. Nations had specialized either in manufacturing, like Great Britain, or in supplying raw materials and foodstuffs, like India (then a British colony).

This pattern had originally benefited manufacturing countries, but it could not last. Formerly unindustrialized nations were already beginning to make products themselves, and some, such as the United States, were even capturing large shares of world markets. Kropotkin conceded that British corporations might improve their profits temporarily by building plants in other parts of the world, where wages remained much lower than at home. But this tactic would not benefit the nation at large: "If high profits can be derived from the work of Indian coolies whose wages are only one-half of those of English workmen, or even less, capital will migrate to India . . . although its migration may mean starvation for Lancashire and Dundee."

Progress must come from another direction, asserted Kropotkin. "It is in *producing for home use*." He believed that international exchange should be avoided except when it is essential. The guiding ideal should be a world "where every aggregation of individuals . . . produces and itself consumes most of its own agricultural and manufactured products."

Of course, the technological means must exist for industry to "produce for the producers," and Kropotkin was excited because innovations of his day promised to help realize this goal.

For England, agricultural production was the test case. By the 1880s, wheat from Argentina, Canada, and the United States had overrun the British market. Land values had fallen sharply; Kropotkin described an eerily silent countryside of ruined orchards and meadows overgrown with thistles. But he contended that England could once more feed itself. New machinery such as steam tractors and mechanical harvestors could lighten farm labor enormously. There were also promising ways to increase yields: enriching the soil with fertilizer, improving drainage, developing a "solar agriculture" of growing crops under glass, and employing modern planting techniques such as crop rotation, careful seed selection, and transplanting.

But to revive British agriculture, Kropotkin stressed that its political as well as technological basis would have to be reconstructed. Imports from America had overwhelmed British agriculture, not because the Midwestern prairies were so inherently fertile—

Kropotkin said they were no richer than most English farmlands—but because American farmers owned and managed their own land. In the United States, machinery and marketing were often arranged through farmers' cooperatives, and government-sponsored experimental stations readily disseminated scientific information. The American model pointed to a "middle way" between "spade culture" and "robbery culture"—between inefficient individualism and militaristic collectivism.

The same belief in autonomous local groups shaped Kropotkin's proposals for industrial reorganization. Earlier technologies based on water and steam power may have favored industrial concentration, but it was a mistake to consider such concentration necessary for technical progress. Kropotkin cited instance after instance of small workshops that had survived and prospered since the Industrial Revolution, not only in the "petty trades," such as shoemaking, distilling, and nail manufacturing, but also in the textile industry. New technologies would further encourage small-scale production.

For example, at the international exposition in Paris in 1889, Kropotkin spotted an efficient steam engine weighing only 46 pounds, ideal for small factories. An even more promising development was the distribution of electric power from central stations: "The municipal supply of electrical power—such as we have, for instance, in Manchester—permits the owner of a small factory to have a cheap supply of motive power, exactly in the proportion required."

But once more Kropotkin emphasized that technological change is of limited value: political change is equally necessary for a truly productive economy. Although industrial concentration rarely aids actual manufacturing processes, it does benefit some capitalists: "When several thousand power looms are combined in one factory, the owner finds his advantage in being able to hold the command of the market." Only when factories are owned by the workers, Kropotkin believed, can the liberating potential of new technologies be realized. In industry as in farming, cooperative labor using the latest technologies is the rational middle way between isolated craftsmanship and gigantic factories, thus merging into the ideal image of "the factory amidst the fields."

Neither Capitalism nor Marxism

Kropotkin's vision belongs to a tradition of thought dedicated to transforming not only the social "relations" by which production is organized, but also the technological "means." This political tradition opposes both capitalism, which controls existing production, and Marxist socialism, which has focused on transforming the relations while tending to ignore the means.

Though it has received far less attention than either Marxism or capitalism, the tradition Kropotkin represents has a long ancestry. Since the earliest appearance of large factories run by steam engines, there has existed an alternate vision of a technology smaller in scale, more in harmony with the landscape, and manageable by local groups. This was the ideal of the great Victorian "prophets," such as Thomas Carlyle and John Ruskin, who often turned to the medieval past for images to contrast with the degraded present. Utopian socialists, including Robert Owen in England and Charles Fourier in France, imagined and sometimes established communities based on a harmonious balance of agriculture and industry. And American pastoralists such as Thomas Jefferson suggested that the ample landscape of the New World could provide an ideal setting for a harmonius union of dispersed industries and agriculture.

But these proposals suffered from two fatal weaknesses. First, the proponents offered little guidance in how to realize their social values through practical politics. The class analysis of Marxist socialism gave it a strategic advantage, locating the axis of social change in the industrial proletariat.

Second, these alternative ideologies were not technologically convincing and therefore tended to be dismissed out of hand. When the distinguished poet Robert Southey wrote his *Colloquies*, contrasting the filthy slums of England in the 1830s with a charming medieval village of rose-covered cottages, he received a brutally sarcastic response from the bumptious and self-assured Whig, Thomas Babington Macaulay: "Here is wisdom. Here are the principles on which nations are to be governed. Rose bushes and poor-rates, rather than steam-engines and independence."

Kropotkin improved upon the vision of his ideological predecessors by describing a middle way wherein technology could be both productive and humane. He also provided a coherent political philosophy. He believed cooperation, not struggle—neither the class struggle of Marxism nor the individualistic struggle of capitalism—stimulates progress. Government should be a network of voluntary associations, organized around shared needs and linked in a loose federalism.

"Reindustrialization" implies that society can restructure industries to be more productive and competitive . . . without restructuring anything else.

Advocates of this middle way have been neglected partly because they have used numerous and confusing terms to describe themselves. Some have called themselves anarchists, like Kropotkin—though his definition of the term was so loose that he called mutual insurance societies examples of "spontaneous anarchism." Others have called themselves socialists, like the English craftsman and writer William Morris, or cooperativists, like the French economist Charles Gide. What is so diffuse tends to be invisible.

Perhaps no one has yet come up with the ideal term for this political movement, but it does have a clear institutional basis. If the foundation of Marxist socialism is labor unions, and that of capitalism is business firms, then the typical institution of the political middle way is the cooperative.

The movement to establish cooperatives was born during the tumultuous, fertile decades of the 1830s and 1840s, and many of the revolutions that spread across Europe in 1848 may be seen as attempts to establish cooperativist republics. Although those revolutions were short-lived, the cooperative movement continued to proliferate, and by 1900 Great Britain had more than 1,400 cooperative retail stores with over 2 million members. Four-fifths of these cooperatives engaged not only in distribution but also in some production, such as baking or boot-making. Including agricultural cooperatives, credit societies, and mutual insurance societies—with 14 million members in Great Britain in 1910—as well as similar associations on the Continent and in the United States, this movement had a total membership dwarfing that of Marxist unions.

Marxists dismiss cooperatives as politically insignificant "bourgeois reformism," not a truly revolutionary force for social change. But Kropotkin redefined revolution. The longer he lived in England, the more he felt that in democratic societies—in contrast to absolutist Russia—experiments in spontaneous anarchism such as cooperatives, municipal socialism, and nondogmatic trade unions might develop within the existing political framework. These germs of the new order could gradually assume political responsibilities while the old statist order became increasingly moribund. The "withering away of the state" would not happen after the revolution, as in Marxist theory, but would *be* the revolution. Instead of being the mechanistic overthrow of the existing order, revolution would be organic—the sprouting of new cells, which would eventually permeate and transform the entire body. This theory of revolution as a process, not an event, complements the ideas of alternative technologies and politics: it is a middle way between reformism and revolt.

An Inspiring Failure

History is ironic, and concepts become realities in unexpected ways. Although Kropotkin addressed *Fields, Factories, and Workshops* to an English audience, it was in France, England's arch-rival, that his vision was most fully realized. More precisely, France had never followed English patterns of industrialization, and French society retained a considerable peas-

ant population, with land ownership divided among many small proprietors. Much industrial production remained small-scale and scattered, geared to specialty and domestic markets. Family-owned firms revolved around household virtues of continuity and stability rather than individualistic traits of acquisition and growth.

Because of these characteristics, the economy of the French Third Republic in the late nineteenth and early twentieth centuries has become a textbook example of the "failure to modernize." But from Kropotkin's point of view, France represented an ideal industrial middle way between economically backward Russia and overindustrialized Britain. He identified the area around Paris—the Ile de France—as the paradigm of the regional economics he advocated. Densely populated and culturally rich, it was highly productive in agriculture because of intensive farming techniques, and equally productive in industry because of the many skilled craftspeople working mainly in small shops.

Kropotkin encouraged French anarchists to organize agricultural and industrial workers in unions (*syndicats*) and to convert existing unions to anarchist principles. This project met with considerable success, largely because it was so compatible with long-standing tendencies in the French labor movement. During the 1890s socialists, conservatives, Catholic socialists, and anarchists competed to establish *syndicats* and cooperatives for landless laborers and small proprietors. Until World War I France provided a very rough approximation of Kropotkin's vision of "factories in the fields," though more because of long-standing social factors than glamorous new technologies.

In Britain, where capitalism was much further developed, most independent artisans had long since become wage laborers, and most landholding peasants had become tenant farmers. The country lacked the social basis to realize Kropotkin's vision. Furthermore, the long-term benefits of the changes Kropotkin advocated were far less compelling than short-term commercial pressures in the opposite direction. For example, members of the English gentry had scant incentive to invest in agriculture when they could get much higher rates of return from foreign investments such as Russian railways. Similarly, business managers saw coal depletion as a remote prospect, while their immediate considerations were low prices and year-round reliability. Demand for coal was reduced only by increasing reliance on petroleum. As world petroleum consumption increased sevenfold from 1870 to 1912, the energy problem was not so much solved as postponed.

All these efforts to cope with the Great Depression created a new industrial order. "Competitive capitalism"—the economic historian's term for the small and often privately owned manufacturing and retail firms of the early nineteenth century—was transformed into "monopoly capitalism." This was dominated by far larger enterprises, often created by mergers and financed by the sale of stocks.

The commercial pressures that shaped and distorted the development of late-nineteenth century technologies were also allied with nationalistic pressures. Beginning in the late 1870s, European nations engaged in a fierce competition for colonies. Though initially spurred by a desire for prestige, the competition became increasingly motivated by economic reasons. Industrial nations valued colonies as new markets, sources of raw materials, and investment opportunities. During the last three decades of the nineteenth century, European nations established dominion over as much of the world as in the previous three centuries.

Imperialism and protectionism fed each other. The decade of the 1870s marked the "great divide," as one economic historian has called it, when nation after nation renounced free trade and returned to some degree of tariff protection. Continental nations granted tariff favors to their colonies, while Britain responded by hurrying to gather still unclaimed lands into her free-trade empire. Even in Britain, calls for "fair trade," like similar protectionist euphemisms of today, began in the 1880s and grew steadily louder.

As competition for colonies and trade grew more heated, so did competition in armaments. In the 1880s naval expenditures began to rise markedly, and Russia and France embarked on ambitious shipbuilding programs to challenge Britian more effectively, with Italy soon following suit. The British, dependent upon the open seas for food and trade, in turn felt vulnerable. In 1889 Parliament passed the Naval Defense Act to raise the British navy fleet to what politicians called a "two-power standard." Soon Japan, Germany, and the United States embarked upon similar programs.

Rapid military buildup caused profound concern, both because of the expense involved and the danger it represented. In 1889 the first peace conference was held at The Hague to try to limit armaments. A ten-year "holiday" from further weapons acquisition was

proposed, but no government wanted to freeze its stockpiles unless it felt sure of military superiority. None of them did.

Around the turn of the century, national competition for colonies, tariffs, and navies transmuted into a series of military encounters. The early episodes involved industrialized powers versus less developed opponents. Americans fought in the Philippines, Europe subdued the rebellious Chinese in the Boxer War, and Great Britain got bogged down in the Boer War. The early twentieth century brought a chain of incidents, reprisals, confrontations, and an ever-rising level of fear and armaments, until in August 1914 the great powers went to war against one another.

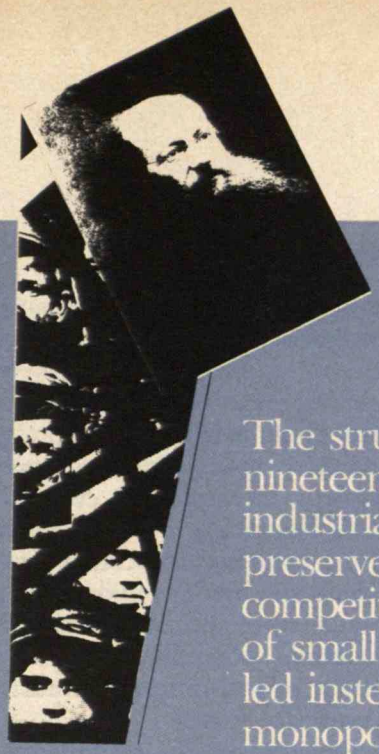
Britain's rise to economic glory had depended upon a temporarily favorable international division of labor, but World War I destroyed that order, and the country's economic decline continues to this day. In France, the Great War slaughtered the peasants and artisans who might have realized Kropotkin's vision. And when the Bolsheviks in Russia took advantage of the disruption of war to overthrow the czarist regime, any promise of a political middle way was overthrown, too. In the 1920s, French syndicalists and other European unionists rallied to Marxist communism as the only viable alternative to capitalism.

The dearest hope of nineteenth-century liberalism was that industrialism and militarism could be mutually exclusive—that trade competition would supplant old-fashioned warfare. Instead, reindustrialization and remilitarization merged.

The Revolution of the Eighties

The question is whether we can learn from this history of depression, social transformation, and war, or whether we are going to repeat it. Unfortunately, the outlook does not encourage optimism. To begin with, the very word "reindustrialization," so popular today, is misleading. It is a neutral term, implying that society can restructure industries to become more productive and competitive—without restructuring anything else. Reindustrialization seems a self-evident goal beyond ideology. The danger is that the term diverts attention from the magnitude of social changes underway.

As the nineteenth century has shown, retooling industry involves altering economic, political, and social structures fundamentally. As early as the 1830s, the advent of industrialization was called the Industrial Revolution, in an explicit comparison to the political upheaval of the French Revolution. It is appropriate to call the late nineteenth-century transformations a second Industrial Revolution, and to recognize that we are living in a revolutionary period today whether we like it or not.



The struggle of nineteenth-century industrialists to preserve the competitive capitalism of small businesses led instead to monopoly capitalism.

Kropotkin's principles remain relevant to the current revolution. He advocated trying to direct social changes rather than being swept along by them, and he believed that economic power should be decentralized so the benefits of industry would be scattered among the whole population.

Decentralizing power is not the same as decentralizing factories. During the 1950s, when the General Electric Co. moved many of its operations from Schenectady, N.Y., to small Southern and Midwestern plants, it did so to escape the unions and high-priced labor. The company scattered its production facilities to maintain centralization of economic power. A quarter of a century later, that example is being repeated on a far larger scale, as factories disperse from the Northeast to other regions of the country and abroad. The result is the collapse of America's former industrial heartland. As in the late nineteenth century, the type of reindustrialization that serves the short-term interests of business may not serve the long-term interests of society.

Another current illusion is fostered by some advocates of appropriate technology and high technology alike, who lean toward a vaguely optimistic technological determinism. While the former are identified with fish farming, windmills, and solar panels, and the later with computers, microcircuitry, and biological engineering, the two groups often proclaim a similar set of social values: more environmental harmony,

a less alienating relationship between people and machines ("user friendliness" in computer jargon), and decentralization.

But the late nineteenth century similarly heralded many technologies that might well be deemed "appropriate," such as intensive agricultural techniques. Other nineteenth-century technologies could be called "high," above all electricity, the glamour industry of the day that was supposed to create a new cottage industry. If these innovations didn't transform society, why should we expect the latest to do so? The pressures of commercialism and nationalism that shaped the evolution of late-nineteenth-century technologies are still powerful forces.

Despite superficial appearances, the overall direction of industrial development today is toward further concentration of economic power. The 500 largest firms in the United States produce goods worth as much as the remaining 400,000 companies. Over the past several years alone, billions of dollars have been invested in mergers rather than in retooling. Monetary policies that result in unprecedentedly high interest rates drive thousands of small businesses into bankruptcy every month, and discourage investment in innovative enterprises, while larger firms can lose hundreds of millions of dollars yet still survive. High interest rates have the same effect on agriculture: independent farmers are disappearing as agribusiness spreads. Other independent workers are also increasingly rare—only 10 percent of the American labor force is self-employed, while a third is employed by the 500 largest firms. If reindustrializing is defined only as introducing high-technology robots, computers, and the like, it holds little promise for reversing these trends.

Solidarity

Proponents of a political middle way would aim to reverse these trends. The problem is that experiments in neighborhood government, cooperatives, community organizing, and the like can be easily absorbed or distorted by centralized economic power and have little effect.

This is precisely what Lenin told Kropotkin in 1919. After the Russian Revolution, Kropotkin had returned to his homeland and was living with his wife in a small village 40 miles from Moscow, gardening and trying to start a cooperative. Though Lenin regarded anarchism as dangerously misguided, he held Kropotkin in esteem and admired his integrity. Kropotkin, for his part, respected Lenin for bringing down the czarist regime, but he was increasingly disturbed by the bureaucratic and militaristic course of the revolution.

An interview was arranged. Kropotkin aired his grievances and argued that strict central control was unnecessary for revolution, citing as examples the spontaneous cooperatives among English dock workers, a small federation in Spain, and the growth of the syndicalist movement in France.

No longer able to contain his impatience, Lenin interrupted. "Is it possible to move on to something new just through that? Do you really think that the capitalist world will submit to the path of the cooperative movement? This small cooperative, a heap of English workers without power, will be crushed and transformed most ruthlessly into the servant of capital: this new rising trend [will be bound] in direct and absolute dependence through thousands of threads which will entangle it like a cobweb. . . . This is all nonsense! We need direct action of the masses . . . which seizes the capitalist world by the throat and brings it down."

"Self-management in the Solidarity movement allows us to confront centralized power indirectly. . ."

Lenin's remarks come to mind when one hears the slogan "think globally, act locally"—as if that approach could alter institutions that have the power to act globally and shape local matters. His remarks also come to mind when the concept of informal "networking" (aided by computers, of course) is raised to the status of a political philosophy. But most of all, Lenin's tirade foreshadowed the fate of Poland's Solidarity union.

In the fall of 1981, a member of the Gdansk delegation to the Solidarity Congress in Poland explained his theory of "soft" revolution: "One of the main things to understand is that the strategy of insisting on self-management allows us to confront the centralized power of the state without ever having to confront it directly. Little by little, authority will be

transferred to the local level, until in the end the state will have lost most of its power."

The Solidarity movement is the most impressive revival in our times of the political middle way: the circumvention of traditional politics for an economic strategy, the reliance on the general strike as a tactical weapon, the attempt to carve out an alternative to Marxism and capitalism, and the hope that a vital human community will replace the moribund bureaucratic state. The repression of Solidarity during the past year only seems to confirm what Lenin said. When push comes to shove, all the interesting experiments in cooperation will be crushed by the prevailing order—the irony being that in Poland, that order is controlled by the heirs of Lenin himself.

But Lenin may not have the last word, neither on Poland nor in general. Solidarity may have made a merely tactical blunder, pushing too hard too fast—although whether to push too little and be absorbed, or to push too fast and risk repression, is the eternal dilemma of middle-way experiments. And it is not at all clear where Poland will be ten years or a hundred years from now.

The middle way of revolutionary change may not be manifest in a dramatic way, like the storming of the Winter Palace. The relevant historical experience may be the Christian revolution rather than the Russian Revolution. Springing up in a remote province of the Roman Empire, from among numerous underground sects, Christianity gradually permeated society until, in 313 AD, the emperor Constantine elevated it to the status of an officially recognized religion.

Changing the concept of revolution also means altering the standard of success. Marxists have often criticized Kropotkin's anarchism as programmed for failure. But to an adherent of the political middle way, the Russian revolution is a failure, and the practice of direct democracy is in itself a success—a desirable end and not merely a revolutionary tactic.

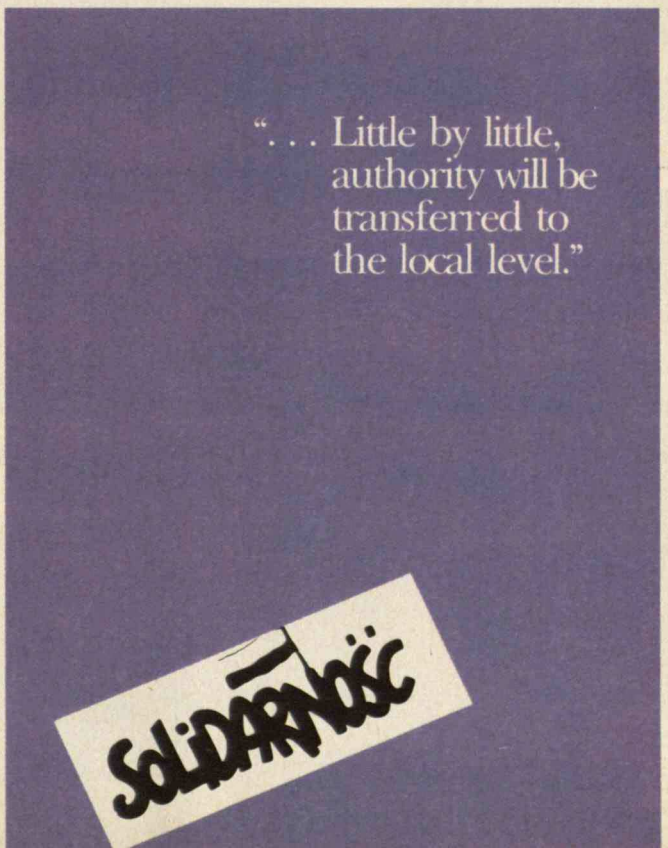
For us the crucial step now is to move in such a direction, even if we cannot foretell the outcome. Only when people think of revolution as a one-time event do they want a list of steps to produce a predetermined result. When revolution is a process, we need a general path to follow—a sense of direction, not a list of directions.

Any move away from the pressures of economic concentration and militaristic nationalism is a step in the right direction. In economic life, such efforts could include initiating worker ownership and management, taking legal steps to break up monopolistic practices, democratizing investment decisions, and providing cheap credit to smaller firms and farmers, as well as establishing cooperatives.

Our vision cannot be limited to the economic realm, however. To proceed in a healthy direction, economic development cannot be pushed off the track by nationalistic pressures. In the early twentieth century, France achieved an internal economic equilibrium that in retrospect appears quite sane, but it could not survive two world wars. Today it is doubtful that any redirection of industry toward a middle way could survive the dangerous and expensive cold war between the East and West.

Edward Thompson, the eminent English labor historian, has recently used the phrase "a third way" to describe what Europeans are trying to do in establishing a nuclear-free zone. "It is not correct to describe Europeans who are working for a nuclear-free zone there as 'neutralist' or 'pacifist,' " he writes. "They are looking for a third way. A third way is an active way: It is not 'neutral' between the other ways; it goes somewhere else."

ROSALIND WILLIAMS, author of *Dream Worlds: Mass Consumption in Late Nineteenth-Century France,* holds a Ph.D. in intellectual history from the University of Massachusetts at Amherst. She researched this article while a fellow at the Science, Technology, and Society Program at M.I.T.



A potential source of electricity or low-temperature heat. This natural salt pond in Israel—and others like it worldwide—could be made to capture and store energy from the sun.

A uniquely simple solar-energy trap is proving an economical source of electricity and low-temperature heat at various sites around the world.

On Solar Ponds: Salty Fare for the World's Energy Appetite

BY MICHAEL EDESESS

IMAGINE an energy-producing technology that uses neither oil nor gas nor coal nor uranium but common salt, a more abundant and less expensive mineral. In this technology, a pound of salt supplies as much electricity or three times as much heat as a pound of coal burned in a combuster. Yet miraculously, after the energy is produced the salt remains, while the coal is used up and its by-products scattered to the four winds, the water, and the soil.

The technology is the salt-gradient solar pond. Now, more than 80 years since its discovery in Transylvania and almost 30 years since the Israelis suggested using it to supply energy, enough information has been gathered to warrant its accelerated development. While financial, political, and technical uncertainties remain, the promise of the technology may be sufficient to bring about its eventual widespread use.

A Natural Phenomenon

The salt-gradient solar pond is not just a feasible technology; it occurs naturally. Discovery of a natural salt-gradient solar pond was first documented in 1902 by the Russian scientist von Kaleczinsky. He found that the water a few feet below the surface of Lake Medve in Transylvania reached temperatures over 185°F—much higher than the temperatures elsewhere in and around the lake. The high temperatures were due to the varying salinity of the water: the bottom of the lake was fed by a bed of salt, while the surface was washed by a continuous stream of freshwater. The resulting "salinity gradient" gave the lake a vertical density difference that allowed it to trap and store solar energy.

Since then, natural salt-gradient solar ponds have been discovered in many parts of the world, including Israel, the state of Washington, the Venezuelan Antilles, and even Antarctica. There Lake Vanda—though perennially covered with a layer of ice—reaches a temperature of 77°F. Even Utah's Great Salt Lake, through an accident of civilization, possesses a slight salt-density gradient and may be experiencing elevated temperatures.

In 1954, the Israeli scientists Rudolph Bloch and Harry Tabor proposed that artificial salt-gradient solar ponds be constructed that trap solar energy even better than natural ponds. These solar ponds could provide thermal energy to heat buildings, drive industrial processes, generate electricity, desalt water, and power cooling systems.

In the years since, salt-gradient solar ponds have been constructed around the world. Most are used for research, but some provide low-temperature heat for various practical purposes. For example, at Ein Bokek, Israel, a pond the size of five football fields provides the national power grid with an average of 35 kilowatts of electricity in summer, 15 kilowatts in

PHOTO: ROBIN MOYER, BLACK STAR

Site-built solar ponds may be used to generate electricity and desalt water where energy is very expensive.

winter, and a peak output of 150 kilowatts, enough to power a large residential complex or office building.

How It Works

To understand how a salt-gradient solar pond works, first consider how an ordinary pond works—how it gains and loses solar energy. Whether filled with fresh or saline water, it absorbs solar radiation in the water and in the material at the bottom. The heated water expands and becomes less dense, quickly rising to the surface and losing its heat to the atmosphere. If you watch a pond on a cool, sunny morning, you can see the heat loss as clouds of vapor.

In the salt-gradient solar pond, dissolved salt is used to create layers of water with different densities—the more salt, the denser the water. The concentration of salt at the surface is low—usually less than 5 percent by weight—and thus the water is relatively light. The salt concentration steadily increases with depth until at the bottom it is very high—around 20 percent.

As salty water near the bottom heats up it expands. However, it cannot rise because it is denser than the less-salty water above. Thus, the solar pond is "nonconvecting"—the warmed water stays trapped below. Some heat is still lost by conduction to the surface, but this process is much weaker than convection. Lower waters may even warm up to, and above, the boiling point of pure water. The highest temperature ever recorded in a solar pond is 227°F, set in the summer of 1980 at the University of New Mexico in Albuquerque.

A salt-gradient solar pond has three zones. Wind, evaporation, and surface cooling in the evening create a surface zone, one-tenth to one-half meter deep, where salinity is low but uniform. Salinity increases in the nonconvecting zone, one to one and a half meters deep. At the bottom is the storage zone, which is typically one to two meters deep but can be as little as half a meter or as much as several meters deep.

The deeper the zone, the more heat is stored. The lowest zone traps heat for long periods, damping the effects of daily and even seasonal changes. This capacity for low-cost storage is one of the chief advantages of salt-gradient solar ponds: they can be tapped for energy at night as well as during the day. Even during long periods of cloud cover or even ice cover, the stored energy is still available.

Depending on location, water clarity, and temperature, the solar pond can capture 10 to 20 percent of the solar energy hitting its surface. Hence, each square meter of pond surface area can supply one-half to two gigajoules of thermal energy per year at temperatures from 100° to 200°F. A flat-plate collector of the same area would be twice as efficient but cost ten times as much.

Maintaining the salt gradient in most solar ponds requires steps that mimic the way nature maintains Transylvania's Lake Medve. Evaporation and mixing of salt tend to increase the salinity of the surface water, gradually destroying the gradient. Hence, low-salinity water must be fed to the surface. Salt must also be added to the bottom of the pond to replace the salt that has diffused upward. Measures to maintain water clarity must also be undertaken.

Heated water is usually extracted from the pond by passing the hot brine through a heat exchanger. The low-cost thermal energy can be used for water or space heating or in industrial processes. It can be used to generate electricity by driving a thermoelectric device or an organic Rankine cycle engine—a turbine powered by evaporating an organic fluid with a low boiling point. The energy can be used to desalt or otherwise purify water for drinking or irrigation. It can drive cooling processes. Most simply, it can be used directly to warm materials in vessels.

Many factors determine whether a salt-gradient solar pond can be used for a particular site and application. These include:

- ☐ Availability of low-cost land, salt, and water.
- ☐ Favorable climatic conditions, including lots of sunny days and high air temperatures.
- ☐ Favorable ground conditions—soil that is impervious to heat and water, lack of moving groundwater, and lack of nearby drinking water that could be contaminated by a salt leak.
- ☐ Low price compared with other energy sources.

The two factors most important in determining how a pond is used are cost and location. Generating electric power and desalting water are inefficient ways to use heat and so require large, low-cost ponds. However, both the electricity and the drinking water can be transported relatively easily, so the end user does not have to be nearby. Natural salt ponds or salt flats are usually low-cost but remote and thus well-suited to these uses. When the low-temperature heat is used directly, the end user must be nearby because heat transport is costly and losses are high. Artificial

A History of Solar Ponds

Work on salt-gradient solar ponds has been in two areas: constructing, operating, and analyzing small ponds, and designing large solar-pond systems.

In Israel, studies of solar ponds began in the late 1950s. The first experimental pond—a 600-square-meter pond built at the Dead Sea Potash Works in 1960—attained a temperature of 205°F, proving that the concept was workable. A larger pond was later built at Atlith, but gas bubbles from the earth rose through the bottom of the unlined pond and upset the operation. This experience emphasized the importance of choosing the pond site carefully and inspecting soil and groundwater conditions.

Activities in Australia paralleled the early Israeli work. In 1964 a 100-square-meter pond was built at Aspendale, Australia. This shallow pond—less than a meter deep—operated for two years. Turbulence in the pond disturbed the gradient, and turbidity reduced the penetration of solar radiation. Nevertheless, the pond heated up to over 140°F. The turbidity of the water was at least partially due to algae growth—a problem later solved by chemical treatment.

From 1966 to 1974 conventional energy sources were so inexpensive that solar-pond research was discontinued. But after the energy crisis of 1973, research resumed with renewed vigor.

Again, Israel was at the forefront of the activity. In 1975 the Israelis built a 1,100-square-meter pond near the Dead Sea Potash Works. The pond captured 15 percent of the incoming solar radiation, reaching 217°F, and heat was extracted from a solar pond for the first time. A 1,500-square-meter pond later built at Yavne provided heat that was used to run a 6-kilowatt organic Rankine cycle engine. Then in 1979, the 7,000-square-meter pond at Ein Bokek was coupled to a 150-kilowatt engine. At that facility, 20 percent of incoming solar energy has been captured during the summer, and efficiencies in converting solar to electric energy have ranged from 0.5 to 1 percent.

Several solar ponds were built in the U. S. between 1974 and 1978. Ohio State researchers built a 200-square-meter pond in Columbus in the summer of 1975. At the same time, a 150-square-meter pond was constructed at the Ohio Agricultural Research and Development Center in Wooster. In the fall of 1975 a 100-square-meter pond was built at the University of New Mexico in Albuquerque, and in 1978 the 2,000-square-meter pond at Miamisburg, Ohio, was built.

In addition to proving that the solar-pond concept was practical, most of these ponds served as useful sources of energy. The Columbus pond, which has been operating continuously longer than any other pond, provides heat for drying crops. The Miamisburg pond—the first designed explicitly for commercial use—provided 144 gigajoules to heat a municipal swimming pool and part of a recreational building until a liner leak forced its overhaul. The Ohio climate is less than ideal for operating a solar pond, yet both the Columbus and Miamisburg ponds attained peak temperatures of 151°F. Even under a winter layer of ice, storage-zone temperatures bottomed out at 84°F. The Wooster pond was used to heat a greenhouse, and the heat extracted from the Albuquerque pond would have been sufficient to heat a single-family home. In summer of 1980 the Albuquerque pond reached 227°F—a record for solar ponds.

Problems with these ponds taught several hard but valuable lessons. Bioorganisms impaired water clarity at the Columbus pond. A combination of copper sulfate, chlorine, and acid treatment suppressed the growth of such organisms. Dead leaf particles stained the water brown; filtration and flocculation with alum cleared the problem. Winds thickened the surface zone, so a network of floating pipes was introduced to control the turbulence. (In Israel, floating nets are used, and in Australia, suspended windbreaks.) Catastrophic liner failures occurred in both the Wooster and Miamisburg ponds, so better methods of ground preparation and liner installation were developed. In all cases, heat loss and mixing at the ponds' walls impaired performance—evidence that larger ponds are necessary for good performance.

Salt-gradient solar ponds have also been built elsewhere in the U.S. In 1981 a 1,000-square-meter pond began operating at the Argonne National Laboratory in Illinois, and this past summer an 800-square-meter pond for heating a 1,500-square-meter storage building warmed up near Flagstaff, Ariz. In April 1982 the Tennessee Valley Authority filled its 4,000-square-meter pond at Chattanooga, Tenn.—the largest U.S. pond in existence. In addition, the University of New Mexico has built a potassium-nitrate pond and the Desert Research Institute in Boulder City, Nev., has built a borax pond. Both are designed to test the concept of "saturated solar ponds," which use salts whose solubility increases sharply with temperature.

Activities in other parts of the world have also accelerated. The 2,000-square-meter pond at Alice Springs, Australia, was built in 1981. The pond heated up very quickly in the highly favorable climate, but it suffered a setback when torrential downpours sapped a large quantity of heat from the pond. Either rainwater runoff passed close to the pond or the groundwater level rose temporarily. Nevertheless, the pond will soon be operating up to par, and developers of future ponds in that region will be careful to adopt designs preventing similar problems.

In India, a 100-square-meter pond began operating in February 1980, the first in a hot, humid climate. Heavy algae growth was controlled by suspending porous bags of sodium hypochlorite in the water.

In Turkey, a prototype sodium-sulfate pond was built solely for precipitating anhydrous sodium sulfate—a remarkably simple means of producing the chemical that is much less costly than conventional means. Small outdoor research ponds have been built in Saudi Arabia and Brazil, and larger ones are planned.

The list of countries active in solar-pond research is growing, indicating a high level of interest in this technology. Experience totals 10 to 15 pond-years in Israel, 20 to 25 pond-years in the United States, and about 10 pond-years in the rest of the world. The work has resolved many major questions and paved the way for building large-scale solar ponds.—*M.E.*

In addition to generating electricity, solar ponds could provide low-cost energy for processing valuable minerals.

ponds are more costly to build but can be constructed near the user. In other cases, a solar pond can be constructed along with mining or industrial activities and even serve as a repository for waste salt, earth, or mining by-products.

Natural Sites

There are very few natural solar ponds—that is, ponds such as Lake Medve that already have the necessary salt gradient. But some existing sites, with a bit of help, can become low-cost solar ponds.

Terminal lakes. Terminal or "closed" lakes such as the Dead Sea or the Great Salt Lake are often highly saline, even saturated with salt. Many also contain valuable minerals.

Developing the Dead Sea as a solar pond is now the focus of Israeli research. In 1979, after a series of experimental ponds, a 7,000-square-meter pond was constructed at Ein Bokek on the shores of the Dead Sea. This pond, the largest salt-gradient pond in existence, has been used to drive an engine that produces 35 kilowatts of electricity continuously, or a peak of 150 kilowatts. The Israelis are now completing the next step—constructing a one-fourth-square-kilometer solar pond with an organic Rankine cycle engine that, at peak operation, will feed 5 megawatts of electricity into the national power grid.

The Israelis' ultimate goal is to construct a 500-square-kilometer solar-pond complex in the Dead Sea itself, separated by floating dikes. The ponds would provide 2,000 megawatts of electricity by the year 2000—adding significantly to Israel's present capacity of 2,700 megawatts. Unlike the Ein Bokek pond, the larger complex would not need a synthetic liner—the pond would simply float on the deep, saturated Dead Sea water. The water just below the gradient would retain heat, but the temperature below that would slowly decline.

This plan requires a source of lower-salinity water. Right now, the "Dead-Med" canal is being constructed from the Mediterranean Sea to the Dead Sea. While the canal will primarily be a source of hydroelectric power, it can also provide surface flushing and makeup water to the Dead Sea solar-pond system.

In the United States, attempts to develop a similar system have led to the design of a salt-gradient pond for the Salton Sea in southern California. Unlike the Dead Sea, the Salton Sea is only about 3.5 percent salt by weight. Evaporation ponds must therefore be built to concentrate the brine.

Solar-pond systems may be appropriate at other terminal lakes around the world. In addition to generating electricity and running desalination operations, such ponds could provide low-cost energy for processing valuable minerals from the lakes.

Salinas. A natural feature that occurs around the world is the salina—a salt flat, marsh, or lake that may be dry or contain saltwater, either continuously or seasonally. The beds of these salinas are composed of clayey earth that tend to block the flow of brine. Some facilities now produce salt and minerals in such areas by evaporation, with only about 3 centimeters of brine seeping through the bottom a year. In some evaporation ponds built below sea level in coastal salinas, no brine has seeped downward. (Some underground seawater has even seeped upward because of pressure equalization.) Salinas with impermeable bottoms and others where the earth can be compacted or treated are ideal sites for salt-gradient solar ponds, especially if water is nearby. Not using a synthetic liner saves $5 to $10 per square meter—$1 to $2 per gigajoule of thermal energy or 5 to 10 cents per kilowatt-hour of electricity. Whether the heat of the brine will affect the naturally low permeability is not yet known.

Consider a hypothetical solar pond in an existing salina—the Sebkha Moknine in Tunisia. ("Sebkha" means "salt lake" in Arabic.) The Sebkha Moknine is about 40 square kilometers in area, lies 3 kilometers from the shores of the Mediterranean Sea, and is about 10 meters below sea level at its edge. The sebkha usually has little or no standing water, and its floor is flat, clayey, and without vegetation. The sebkha is surrounded by roads and settlements and is close to the industrial cities of Sousse and Monastir.

To create a salt-gradient solar pond, a small canal would have to be built from the Mediterranean to the sebkha. The developers would feed seawater continuously from the canal into the sebkha and allow it to evaporate until it is 20-percent saline. The developers would then establish a 1-meter salinity gradient by feeding low-salt water through a submerged diffuser. (This mixing technique—called "redistribution"—has been used to establish the salinity gradients in other ponds.) Finally, the developers would add more seawater to form a surface layer, and add highly concentrated brine to replace the salt lost from the bottom by upward diffusion. The brine

could be produced by evaporation in a portion of the sebkha not used for the solar pond.

The heat fron the solar pond could drive an engine for generating electricity or much-needed drinking water from seawater. The pond could provide about 600 gigawatt-hours of electricity or 100 million cubic meters of drinking water each year—a substantial contribution to the country's needs.

The Sebkha Moknine is only one of many coastal sebkhas in Tunisia and other countries in Africa and the Middle East, and numerous other salinas exist around the world. There is undoubtedly enormous potential for developing solar ponds at these natural features.

Site-Built Solar Ponds

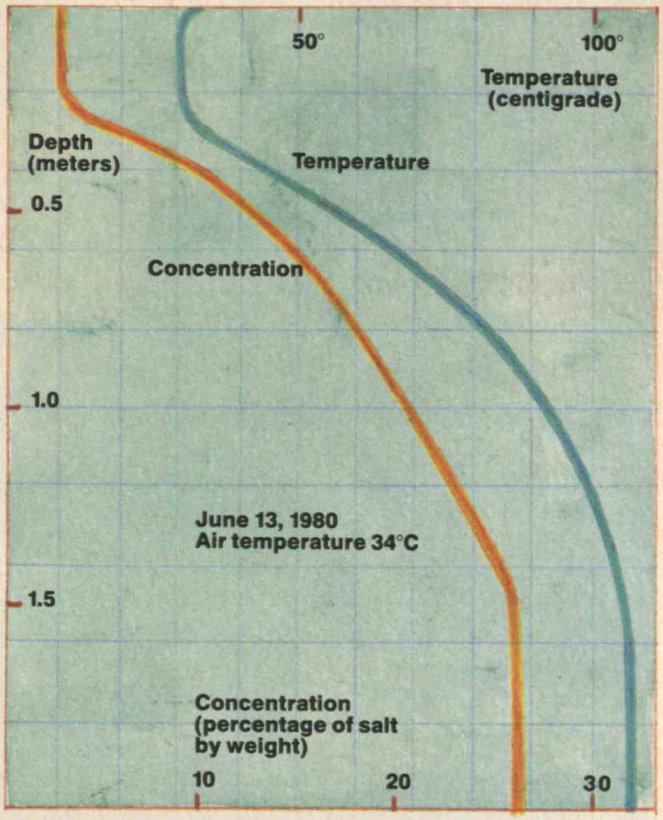
"Site-built" solar ponds are constructed near the point of end use rather than at a more advantageous location such as salt flats or mines. Building these ponds requires digging, leveling, and preparing the ground. A liner made of a synthetic material that will stand up to contact with hot brine is usually added. Salt or brine also must be transported to the site by truck, rail, or pipeline. Thus, site-built ponds are more costly than natural ponds and usually smaller. Although site-built ponds are most often used to provide heat, they may also be used to generate electricity and desalt water where energy is very expensive.

Most artificial solar ponds have been site-built, primarily because they have been constructed either for research or for small-scale thermal applications, such as heating a swimming pool or greenhouse. Building a small, site-built pond does not require a massive capital investment, while constructing the larger, more advantageously sited solar ponds requires launching a substantial venture.

The following are a few examples of the many ways site-built solar ponds can be used.

Heating water at seaside resorts. A 2,000-square-meter salt-gradient solar pond has been built at Miamisburg, Ohio, chiefly for heating the water in a municipal swimming pool. Using such ponds at large seaside resorts would be even more economical because resorts tend to be in favorable climates. In addition, resorts have many uses for low-temperature heat—most have whirlpool baths and heated swimming pools, as well as large demands for hot water for bathing and cooking. A solar pond of about

Salinity and temperature profiles from a salt-gradient solar pond at University of New Mexico on a June day in 1980. After the first quarter-meter, both salinity and temperature increase steadily with depth until they level off at 1.5 meters below the surface—the start of the storage zone.



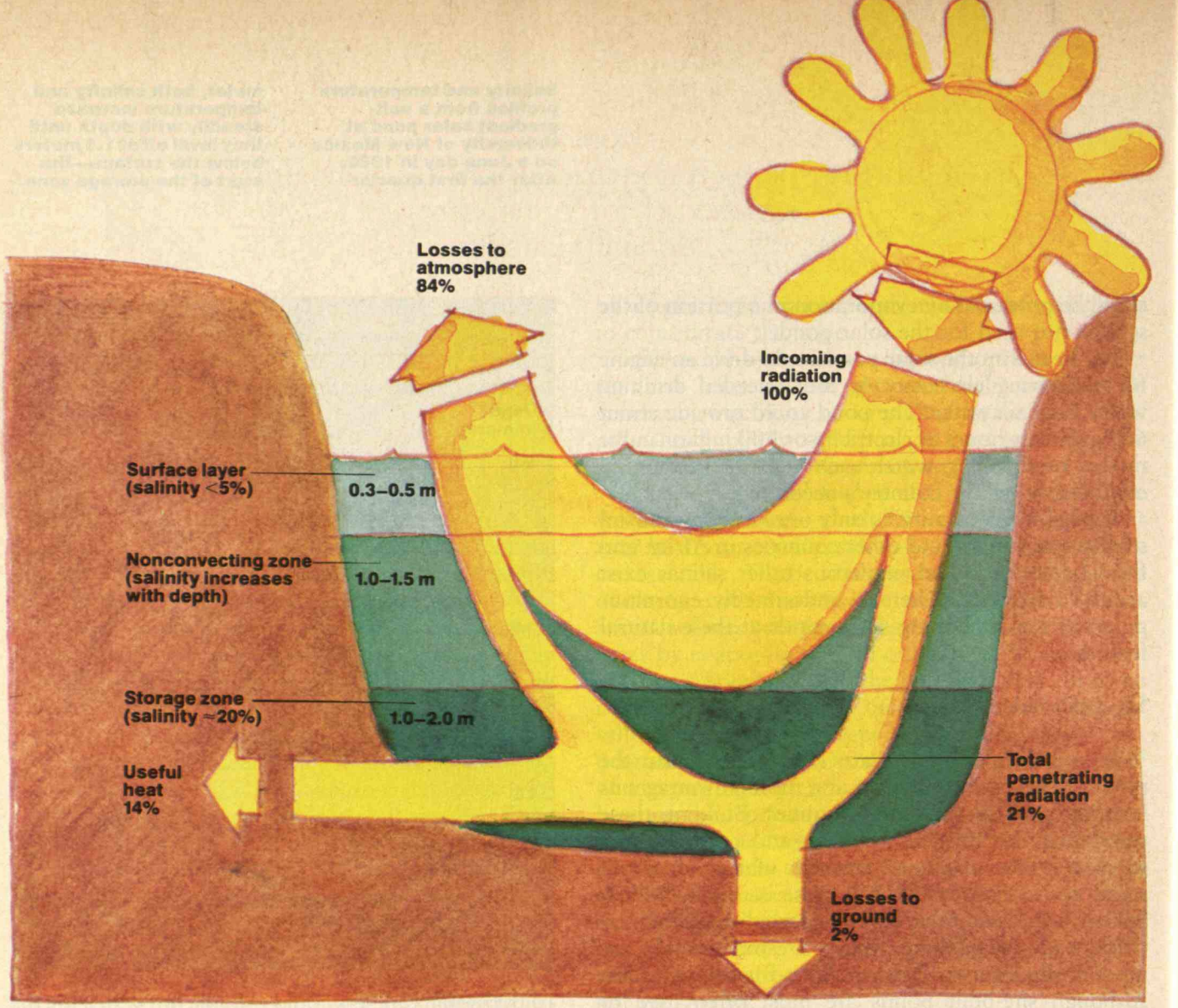
10,000 square meters could provide hot water for the resort while serving as a tourist attraction.

Space heating and cooling in the American Southwest. Many residential and commercial complexes in the South and Southwest require both space heating in winter and cooling in summer. A single solar pond could provide direct heat in winter and thermal energy to drive an absorption cooler in summer. Of course, the pond could be designed to blend in with existing buildings, and measures would have to be taken to prevent people from falling into the pond.

Although less solar radiation reaches higher latitudes, using salt-gradient solar ponds for space heating has been proposed for locations as far north as Maine. A pond at the University of New Mexico has produced enough heat to fulfill the needs of a single-family home in Albuquerque for several years. Solar-pond-driven cooling, although feasible, has not yet been practiced.

Heating animal housing and drying crops on farms. Low-grade heat can be used in many ways on farms, which have enough land for solar ponds. Several small demonstration ponds in Ohio, Iowa, and Illinois have been used to heat greenhouses and hog

DIAGRAMS: ED PORZIO



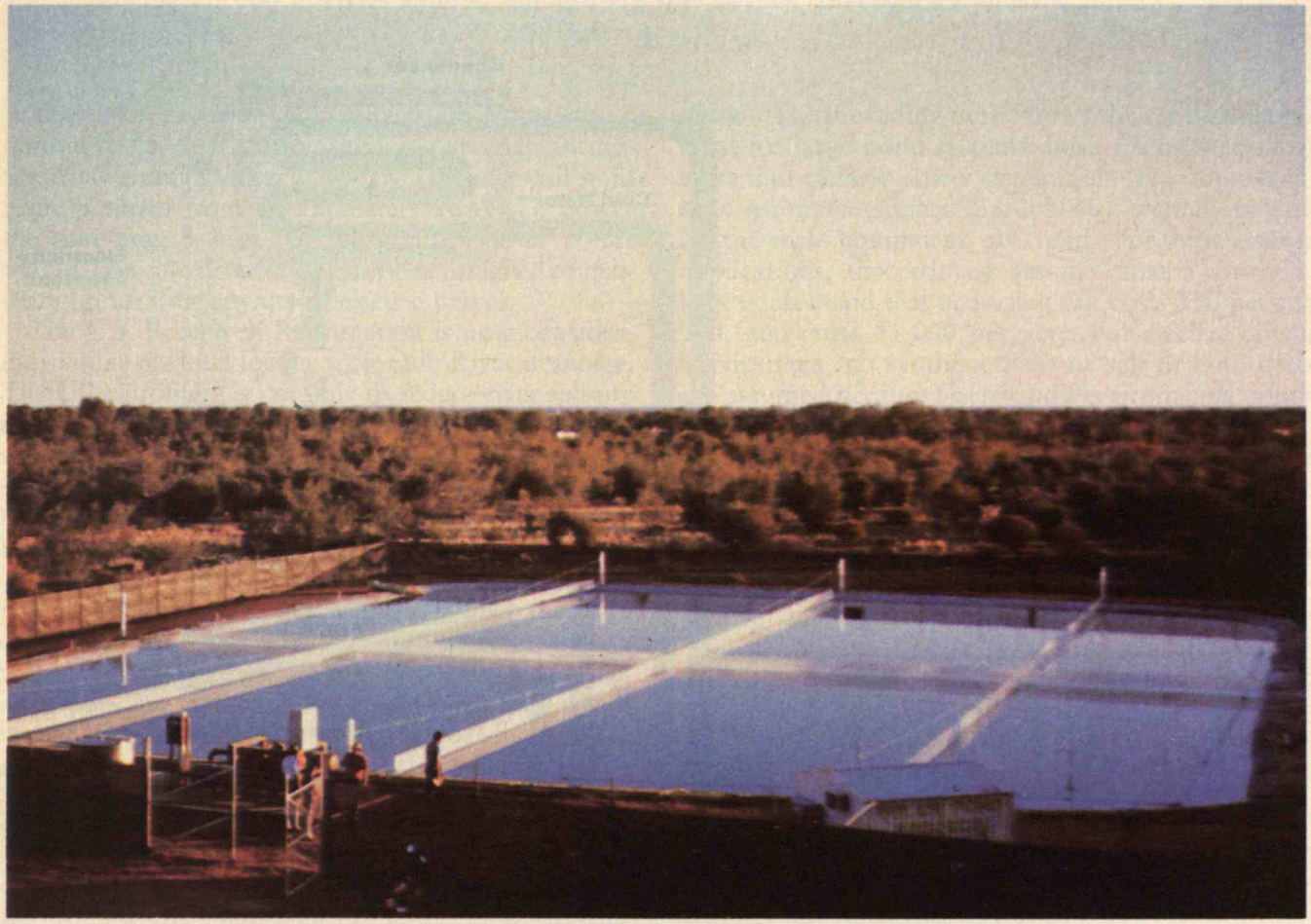
How it works. A salt-gradient solar pond has three zones—a low-salt surface zone, an insulating zone that increases with depth, and a high-salinity energy-storage zone at the bottom. About a fifth of the sun's energy reaches the water in the storage zone. The water becomes warm and buoyant but can't rise because it's denser than the less-salty water above. Unable to lose its heat, the water becomes hotter and hotter, and sometimes even boils. The trapped solar energy is extracted by withdrawing the hot brine through pipes and passing it through a heat exchanger.

barns. Extra care must be taken in lining these ponds to avert any danger of polluting groundwater with salt.

Heat for biomass conversion. Site-built solar ponds could provide heat to convert biomass to alcohol or methane. While no solar ponds have been used for this purpose, it is an ideal coupling of two renewable-energy technologies.

Generating electricity or desalting water in outback Australia or tropical islands. In remote Australian villages, electricity can now cost more than $1 per kilowatt-hour. A 2,000-square-meter solar pond equipped with a 20-kilowatt engine has been constructed at Alice Springs, Australia. The pond is just beginning to operate, but even such a site-built pond will probably be competitive with the alternatives in these villages. Electricity is also expensive on many tropical islands. Here again, site-built solar ponds used for generating electric power or desalting seawater are likely to be competitive.

Cooking in the Third World. In southern India, western Africa, and many other less-developed countries, deforestation from the use of firewood for cooking is a major problem. Since temperatures in a solar pond are similar to those in the common American "crock-pot," or slow cooker, food could be cooked by dunking a pot in a salt-gradient solar pond. This practice would save untold quantities of firewood, not to mention the time taken to gather it. Surprisingly, a solar pond requires only one-thousandth as much land area as forests to fuel cooking. Such solar ponds would be small—a 100-square-meter pond could serve a village of 50 to 100 families. How to maintain the ponds, avoid contamination, and introduce new cooking techniques are major questions, but the potential payoff is large.



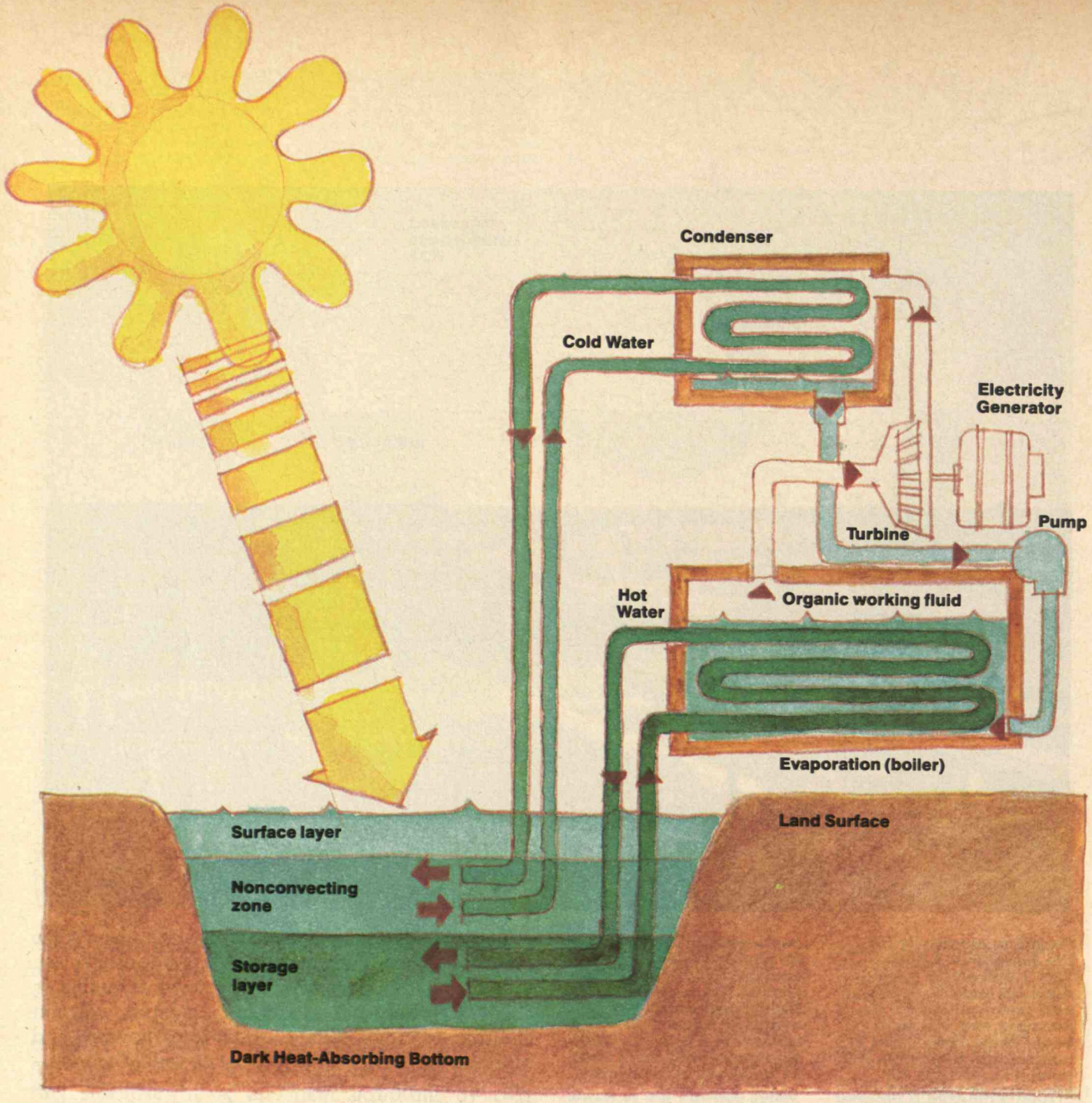
Providing electricity for the Australian outback. This 2,000-meter pond at Alice Springs, Australia, is now undergoing final adjustment and will soon begin generating. Once in commercial operation, the pond will produce 10 kilowatts of electricity continuously, or a peak of 20 kilowatts—enough energy to power a nearby winery. The electricity should cost around 35 cents per kilowatt-hour—a bargain in a region where electricity now costs from $1 to $3 per kilowatt-hour.

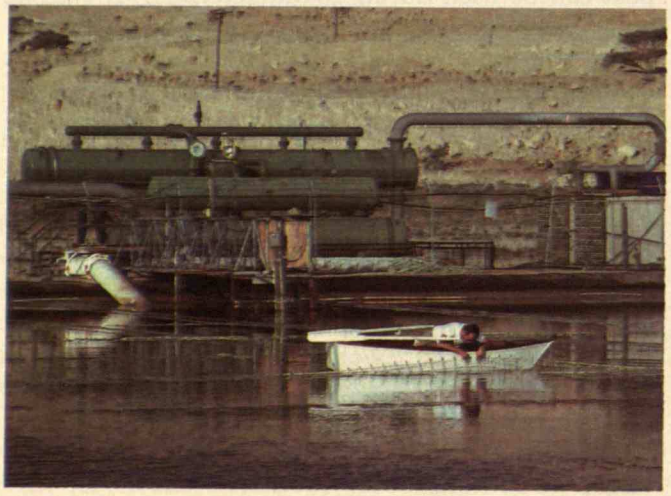
Solar Ponds and Other Uses

Processing chemicals, mining minerals in solution, using smokestack scrubbers in coal-fired power plants, and—potentially—producing synthetic fuels yield large amounts of waste brines. Brine is also produced when oil wells are drilled and salt domes are excavated for storing gas, oil, or waste material. The brine is usually held in "impoundment ponds," which are sometimes lined to prevent groundwater contamination. Often the ponds are permanent, but in some industries such as oil drilling, the brine is later reinjected into the earth.

These ponds could be made into salt-gradient solar ponds very economically. Site-built ponds usually use sodium chloride, but the waste products of mining or chemical processing—magnesium chloride, calcium chloride, sodium sulfate, sodium carbonate, and other salts—could do the job just as well. Their location makes such ponds even more economical: the heat can be used during manufacturing, for cooling and heating natural gas, for separating oil-water mixtures, and for many other purposes. Some minerals can be processed right in the pond itself by precipitation. Eventually, energy from solar ponds may be used to clean up mining and industrial wastewater.

However, the largest impoundment ponds will be created when salty water is diverted to keep it from polluting river drainages. Planning and constructing such impoundments has already begun in several parts of the U.S. The Army Corps of Engineers is now constructing Truscott Brine Lake, about four square kilometers in area, near Childress, Tex. The project is designed to divert brine springs and tributaries that would otherwise flow into the Red River and make it too salty for irrigation or drinking.





Above:
From hot brine to electricity. The energy stored in the bottom of the Ein Bokek pond drives an "organic Rankine cycle engine." Hot brine from the pond is circulated through an evaporator that contains an organic fluid with a low boiling point. Low-temperature heat from the brine turns the fluid to vapor. The vapor flows under high pressure to the turbine, which drives the attached electric generator. The vapor then flows to the condenser, where it is cooled (by cold water pumped from the top of the pond) back to liquid form and returned to the evaporator.

Left:
Checking the water in the world's largest existing salt-gradient solar pond. This 7000-square-meter pond was constructed in 1979 at Ein Bokek, Israel, on the shores of the Dead Sea. Behind the technician and his boat loom the evaporators, turbines, and condensers of the power plant run by the pond's heat. The Ein Bokek pond produces 35 kilowatts continuously, or a peak of 150 kilowatts.

PHOTO: ROBIN MOYER, BLACK STAR

Even during long periods of cloud cover or even ice cover, stored energy is still available.

The lake is being constructed by damming a natural basin, and is being sited in a geologic formation that is impervious to water. The lake will hold brine pumped from 40 kilometers away. To power the pumping, a series of salt-gradient solar ponds within Truscott Brine Lake has been designed to generate up to 5 megawatts of electric power.

The U.S. Bureau of Reclamation is now considering similar projects for the Colorado River drainage. There the problem is not only to reduce river salinity but to guarantee a minimum annual flow of water, as specified by treaty with Mexico. Thus, energy from a solar pond might be used to desalt water to be returned to the river. The bureau is considering a combination of uses for the diverted saline water. The brine would first be used to slurry coal to a remote power plant, where the brine would then be used as a coollant. Then, after becoming too concentrated, it would be "disposed of" in specially built salt-gradient solar ponds. Thermal energy from those solar ponds would preheat boiler water for the coal-fired power plant, saving about 5 percent of the coal.

Projected Costs for Large-Scale Systems

Costs of $35 per square meter have been quoted for the Miamisburg pond and $73 per square meter for the Argonne pond (*See "A History of Solar Ponds," p. 61*). However, these figures provide little information on the estimated costs for large-scale systems. For one thing, separating R&D costs from construction costs is difficult. More significant, though, is the substantial risk factor that some contractors add when they work with new technology, even though it may not require anything unconventional. Thus, costs for constructing the containment area of solar ponds have exceeded costs for more common waste-disposal and water-holding ponds.

Large solar ponds, because of economies of scale, would seem to be less expensive than small ones, but estimates vary widely depending on the site, use, and design. The preceding table shows the estimated unit costs for large pond systems, both for heat applications and electric power generation. The "conservative" estimate assumes that low-risk technology and off-the-shelf equipment are used. For heat energy applications, the estimate assumes that a synthetic liner is used and that acquiring salt costs $10 per ton and land costs $1,000 per acre. For electric power applications, no synthetic liner or salt or land costs are assumed because electric power-producing ponds will be built only at suitable sites. In the "best-case" estimate, advanced technology and equipment will be used, and no salt, synthetic liner, or land cost is used even for thermal energy applications.

Estimated cost of large solar-pond systems

	Dollars per square meter of pond area	
	Conservative	Best case
Thermal energy	28	7
Electricity (baseload)	20	12

The table below shows estimated performance for large pond systems, both for thermal energy applications and for electric power. Heat is assumed to be provided at an average temperature of 167°F. The "conservative" estimate assumes only an average site: solar radiation is 6.7 gigajoules per year, the average air temperature is 63°F, and the optical quality of the water is fair. The "best-case" estimate assumes a superior site: solar radiation is 8.5 gigajoules per year, the average ambient-temperature is 73°F, and the optical quality of the water is excellent.

Estimated performance of large solar-pond systems

	Megajoules per square meter per year	
	Average site	Superior site
Thermal energy	900	1700
Electricity (baseload)	55	110

Combining these two tables and using a 20 percent annual charge to amortize capital costs leads to the energy cost figures—for thermal energy and

	Dollars per gigajoule	
	Conservative	Best case
Thermal energy:		
Average site	6.22	1.56
Superior site	3.29	0.82
Electricity:		
Average site	26	16
Superior site	13	8

Under ideal conditions, solar ponds may be competitive with large central power stations.

electricity—shown above. For thermal energy applications, solar ponds are competitive. For electricity, solar ponds are competitive for off-grid and remote applications, and under ideal conditions they may be competitive with large central power stations.

Where to from Here?

At least three areas of uncertainty will have to be resolved before large solar ponds can contribute significantly to energy needs.

☐ The surface layer may thicken despite grids of wave-suppressors, particularly in large ponds. Injecting concentrated brine at certain depths can limit the surface zone, but this and other control techniques require more study.

☐ The economics of using solar ponds to generate power and desalt water depend largely on the ability to operate without a synthetic liner. Evaporation ponds built in salt flats for producing minerals have very low permeabilities. But the brine in salt ponds will be hot, and its effect on permeability is uncertain.

☐ Some solar ponds lose much more heat to the ground than predicted. The heat is thought to vaporize moisture in the earth below; the vapor then travels through the earth, carrying heat away. These properties must be researched, especially where groundwater is present near the pond.

As more and larger solar ponds are built, many other aspects of the technology will become better understood. For example, locations of the outlets for extracting hot brine from the storage zone must be carefully planned, or "cold spots" may develop. If outlets are misplaced or if outlet flow is too high, turbulence may result, eroding the salinity gradient.

Also important are troubleshooting and maintenance procedures. So far, maintenance has been very labor-intensive. Routine, semiautomated, and cost-effective systems must be developed.

Solar ponds must be built on a larger scale, but this poses a chicken-and-egg problem. Large solar ponds require capital, and those with the means usually finance only technologies they are convinced will work.

How can this vicious cycle be broken? Subsidies and spin-offs from government programs have been the impetus to developing many large-scale technologies. Although federal programs now support important solar-pond research, the U.S. government is unlikely to provide seed capital for building the ponds. Other countries that are both relatively well-to-do and energy-constrained such as Israel, Australia, and tropical island nations could step into the breach. Many oil-rich countries also have extra funds and unique energy requirements, such as the need for desalting water at remote sites. Some, such as Saudi Arabia, are now showing serious interest in solar ponds.

There are strong incentives for building privately or semiprivately funded solar ponds in the United States. The earliest attempts are likely to occur along with waste-salt disposal. Some chemical and mineral-processing industries that require low-temperature heat also produce a waste brine suitable for solar ponds. Although these industries can benefit uniquely from solar ponds, they may be reluctant to foot the bill of a new technology.

One solution is for developers to take advantage of a federal tax credit while using a standard source of risk capital—individual investors seeking a tax shelter. The developer would form a private organization to finance and construct a solar pond at an industrial site and then sell the energy to the industry. The developer could project an excellent return for such an investor. The same approach could be used to finance solar ponds for heating homes or businesses.

The development of solar ponds is likely to depend in the long run on energy demand. Demand for renewable, locally controlled, and low-cost energy sources will increase as prices rise. Among such sources, salt-gradient solar ponds rank near the top.

Further Reading

☐ Nielsen, C.E., "Nonconvective Salt-Gradient Solar Ponds." In *Solar Energy Technology Handbook, Part A: Engineering Fundamentals*. New York: Marcel Dekker, 1980, pp. 345-370.

☐ Peelgen, M.L., "Salton Sea Project, Phase 1: Final Report. Jet Propulsion Laboratory #81-108, DOE/ JPL-1060-44, January 1982.

☐ Solar Energy Research Institute. *Conceptual Design of the Truscott Brine Lake Solar Pond System*, vol. 1: *Utility-Independent Scenario*. SERI/TR-731-1202, June 1981.

☐ Tabor, H., "Solar Ponds." *Solar Energy* 27, #3 (1981): 181-194.

MICHAEL EDESESS, an energy and investment consultant, is manager of energy R&D marketing for Flow Industries, Inc., in Denver. He holds a Ph.D. in mathematics from Northwestern University.

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ROLEX

Modeling the Performance of a Solar Pond

by Eric Adams and Joe Atkinson

To predict the behavior of solar ponds and optimize their design, researchers must first be able to predict variations in temperature, salinity, and density that result from water inflows, outflows, and vagaries of the weather. One of the biggest uncertainties is the effect of surface wind mixing. Wind energy—specifically, wind-induced waves and currents—causes the upper layer of the pond to deepen, greatly reducing the pond's collection efficiency. The thickness of this upper layer should be kept to a minimum.

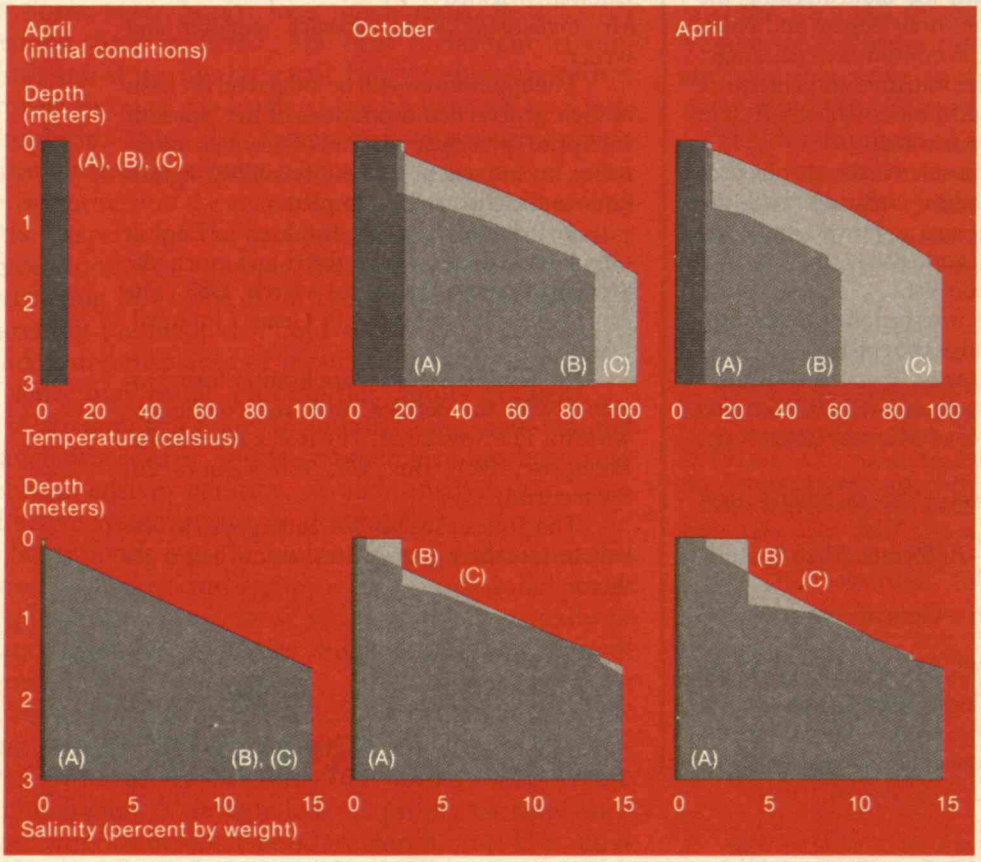
To guard against wind mixing, the Israelis have installed plastic wave suppressors in their ponds, including the 7,000-square-meter pond at Ein Bokek near the Dead Sea. A similar system has also been suggested for the proposed facility on California's Salton Sea. It consists of a rectangular grid—strips of netting 1 meter wide and 5 meters apart. These nets appear to work for small ponds, though detailed studies have not yet been conducted. For comparison, the Israelis are also planning field tests on another pond without wave suppressors.

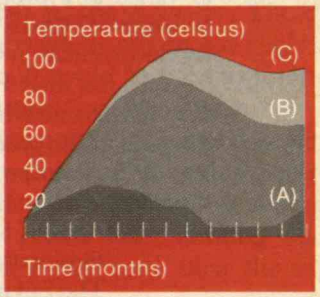
Wind mixing is expected to be an even greater problem on larger ponds. As surface area increases, magnitudes of wind-generated waves and currents grow, leading to enhanced mixing. And greater flow rates of larger ponds exacerbate the process.

Researchers at M.I.T.'s Parsons Laboratory for Water Resources and Hydrodynamics (W. Kenneth Melville, Donald Harleman, Atul Salhotra, and the authors) are using computer models to predict how salinity and temperature change with day-to-day pond operation and meteorological variables such as air temperature, humidity, wind speed, and solar radiation. The model takes into account radiation absorption, heat exchange with the atmosphere and ground, diffusion of salt and heat, turbulent mixing, advection, and other physical processes governing pond response. Similar descriptions of wind mixing have been successfully used to model temperature gradients in oceans and lakes.

To improve understanding of pond dynamics, researchers will soon be conducting experiments in a temperature- and salinity-stratified wind and wave tunnel. In this facility, variables such as pond length and depth, gradients of temperature and salinity, and wind speed can easily be varied, and the resulting changes in temperature profile can be readily documented. Results from these experiments, as well as the Israeli ponds (with and without wave suppressors), will be used to refine the computer model. This should help establish optimal pond sizes and determine whether wave-suppressors will be necessary. □

Eric Adams is a principal research engineer at M.I.T.'s Energy Laboratory. Joe Atkinson, a graduate student at M.I.T., is a research assistant in the Parsons Laboratory.





Predicted temperature and salinity profiles for a 3-meter-deep solar pond operating near Richmond, Va. The upper figure shows typical seasonal variations in the temperature of the storage layer, assuming that no heat is extracted from the pond. At left the figures show vertical temperature and salinity profiles at several times during the year. Curve A represents an ordinary pond without a salt gradient, curve B is a solar pond subject to wind mixing, and curve C is the same solar pond without wind mixing. In each case, it is assumed that fresh water is added to the surface to make up for evaporation losses.

DIAGRAM: OMNIGRAPHICS

SCIENCE/SCOPE

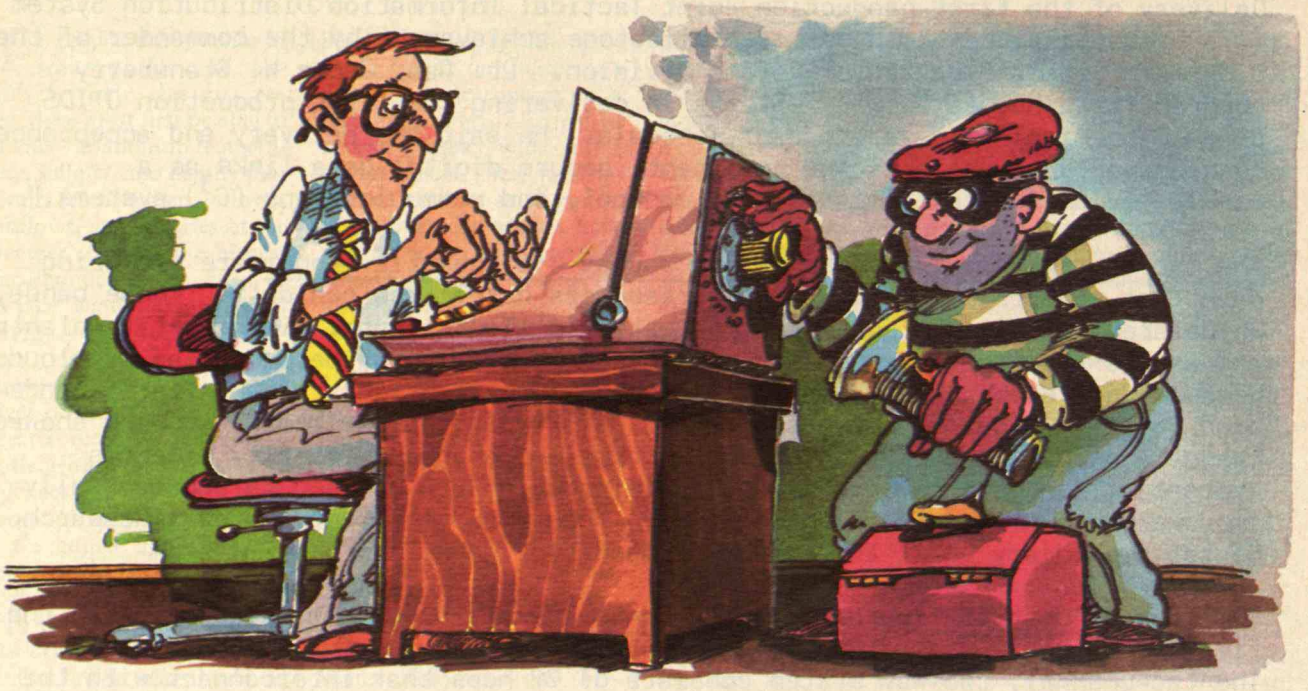
Delivery of the first production Joint Tactical Information Distribution System (JTIDS) terminal has been called a milestone achievement by the commander of the U.S. Air Force's Electronic Systems Division. Lt. Gen. James W. Stansberry congratulated Hughes for its efforts in delivering the first production JTIDS Class 1 terminal 31 days ahead of schedule. He said the delivery and acceptance "demonstrably establishes jam-resistant, secure digital data links as a viable medium for tactical command, control, and communications (C^3) systems."

The two shortwave infrared bands on Landsat 4's thematic mapper are gathering data that sensors on previous Earth resources satellites couldn't. These bands, which are sensitive to the amount of water in plant leaves, will identify plants and assess their health. They can map snow cover without being fooled by clouds because snow appears very dark, while clouds remain bright. The infrared bands also detect a wider variety of rock and soil types. Experimental studies showed these bands can identify variations in type and abundance of clay minerals exposed at the Earth's surface. This information can be used to substantially improve the quality of geological maps. Hughes and its Santa Barbara Research Center subsidiary built the thematic mapper for NASA.

A microwave distribution network for Pennsylvania educational television is the first large-scale use of Hughes AML equipment configured for FM transmission. The two-channel, two-way system consists of 22 hops that interconnect with the network that had already been operating in a portion of the state. It is being operated by the Pennsylvania Educational Communications System, a non-profit organization whose membership includes leading independent cable companies. Hughes AML equipment, which traditionally has employed AM techniques, has been used for local distribution service in the cable-TV industry since the late 1960's. It now serves more than 20,000 video channel paths worldwide.

A series of bias-tuned Gunn oscillators that offer improved power output and tuning bandwidth characteristics has been added to the Hughes line of solid-state millimeter-wave receiver products. The oscillators are available in U band (40-60 GHz) through W band (75-90 GHz) and in several output/tuning bandwidth combinations. Bandwidths vary from 200 to 1000 MHz, power output levels vary from 5 milliwatts to 100 milliwatts. Low-noise characteristics make the units particularly suited for uses like paramp pumps and local oscillators.

Hughes Missile Systems Group in Tucson, Arizona, has built a reputation for the development and manufacture of sophisticated electronics. We have enhanced our leadership in this field with these missiles: the electro-optical/laser/infrared-guided Maverick, the radar-guided Phoenix, the wire-guided TOW, and now the radar-guided AMRAAM. We have openings for microwave specialists, circuit designers, hybrid microelectronic engineers, and production support test engineers. Send your resume to Professional Employment, Dept. SE, Hughes Missile Systems Group, P.O. Box 11337, Tucson, AZ 85734. Equal opportunity employer.



Encryption: Can Spies and Thieves Break It?

Electronic thievery is an increasing threat from big players rather than lone-wolf operators with mere larceny at heart. For example, computer-aided Soviet snoopers may have victimized U.S. farmers in the "great grain robbery" of 1974. There is strong evidence that the Soviets programmed a computer to identify, intercept, and record phone conversations of Agriculture Department officials, according to Harry Rositzke at the CIA. Using inside information about the U.S. grain market, the Russians negotiated a deal far below fair market price.

The way to stop computerized theft is by using encryption. To do this, information must be expressed in terms of digits. (Even telephone conversations, like some recent recordings, can be "digitalized.") An encryption device then scrambles the digits so they become unintelligible to any intercepter.

The basic encryption method—the mathematical scrambling procedure—is embodied in electronic circuits. The circuit design is mass-produced and can be public knowledge, like the basic mechanism of a combination lock. But to encrypt a message, you program the device with a particular "key," a series of numbers like a combination. Only someone who knows that key can decipher the message—if everything works as intended.

In 1977, in response to concern about computer crime, the National Bureau of Standards, together with the National Security Agency, certified one encryption method—a basic set of scrambling formulas embodied in an electronic circuit design—called Data Encryption Standard. DES is intended to protect the economy from spies and terrorists, and it promptly won the backing of the Federal Reserve Bank, which required all banks to use it when communicating with the Fed. Liability considerations have also encouraged many businesses to use DES. "If we were using some encryption method other than DES and things went wrong," explained one financial official, "we could get sued and our insurance wouldn't cover it."

But a rising storm of protest within the cryptographic community has questioned how secure DES really is. As long ago as 1976 Robert Morris and two colleagues at Bell Labs speculated that DES may contain a "trap door"—a way for someone who doesn't know the secret key to decipher a message.

Cryptographers' suspicions are related to a particular part of the DES device. The encryption device permutes digits (like shuffling cards in a deck) and substitutes digits (like replacing cards in one deck with cards from another). The design principles behind the "S" boxes—the electronic circuits that substitute digits—were classified by the National Security Agency (NSA). This is what raises concern. Without knowing the rationale behind the "S" boxes, no one is altogether clear what they may do.

One of the "S" boxes is especially suspicious because, according to Ralph C. Merkle of Elxsi, Inc., in Sunnyvale, Calif., it "is only one-quarter there": three-quarters of the box appear to be doing nothing for the process of encryption. Nobody knows what this mysterious part of the box is for, but it could, in theory, have been added by

the NSA to allow it to decode messages. When Morris and his colleagues at Bell asked one of the cryptographers who designed DES about the "S" boxes, he replied, "You must trust us. We are good Boy Scouts."

Merkle says that to assume that the "S" boxes house a trap door would be "paranoid." But even if there is no trap door, some experts think DES is vulnerable for other reasons. Stanford electrical engineering professor Martin Hellman takes issue with cryptographers who say it would require hundreds of years for any computer to crack DES. He points out that the same job could be done by a specially designed chip, and thousands of them working together could accomplish it in minutes.

"DES is enough to keep out the riffraff," assures Merkle, who has collaborated with Hellman in some of his cryptographic work. But a foreign government or well-financed terrorist group might be able to invest the $20 million Hellman thinks would be needed to break DES. "It's just a matter of time before a terrorist organization will strike a blow . . . by disrupting important business transactions, destroying computer data files, or completely disrupting the orderly financial transactions of the banking community," warns a study by Marketing Consultants International.

An official with the American National Standards Institute thinks that Hellman underestimates the difficulty of cracking DES. If anybody were trying to, says the official, it would be obvious because "they'd keep two entire semiconductor factories busy for a year."

But if DES is so secure, one wonders why U.S. law forbids using it to transmit classified documents. And just in case it's broken someday, Dennis Branstad at the National Bureau of Standards would like to find a backup method—a device whose electronic circuits embodied a mathematically different approach to scrambling—so people wouldn't have to carry secret messages around in locked briefcases.—*Carolyn Meinel* □

A Better Encryption Technique: Maybe

On the evening of August 23, 1982, nearly 200 mathematicians gathered in an auditorium at the University of California at Santa Barbara for the Crypto '82 Conference. They were there to witness what some would later call a classic contest of cryptographic skill.

The champion being challenged was a "public-key" encryption method. Public-key encryption is a promising way of encoding electronic messages to protect them from spies and thieves in our computer-based economy. You have a public "key" known to everybody, consisting of a sequence of digits, like a lock combination. You also have a matching private key, known only to you. Anyone can use your public key to scramble and send a message, but only you, using the corresponding private key, can decipher it.

With such an encryption method, you never have to give your secret code to anybody else. Other encryption methods in effect use a single secret key to scramble and unscramble a message. With these methods, you have to pass your secret key around to everyone who sends you messages.

As recently as last March, Public Key Systems Corp. boasted that cracking its public-key encryption method was "far beyond any technology ever likely to be developed." However, statements like that are beginning to ring hollow. In April math professor Adi Shamir of the Weizmann Institute of Science in Israel broke a public-key encryption method called the "knapsack" technique. He himself had coinvented another method to achieve public-key encryption known as "Graham/Shamir"—the one being challenged at the Crypto '82 conference.

Challenger Leonard Adleman, associate professor of computer science at the University of Southern California, claimed he could discover the secret key by examining only the public key. But his colleagues told him his method was "too complicated to prove mathematically," so he responded by trying to demonstrate it under the scrutiny of the world's top cryptographers.

"These conferences can be kind of dull," says Adleman. "So we decided to put on a circus." In front of the assembled mathematicians, he explained that he wanted to break Graham/Shamir. He left the auditorium while several cryptographers used his Apple home computer to generate public and secret keys. They entrusted the secret key to one colleague from Bell Labs and another from the National Security Agency (NSA), and gave Adleman the public key.

He took his Apple back to his room and set it to work. Tuesday morning he awoke to discover the computer's solution for the secret key. But being a good sport, he kept it until the cryptographers reassembled in the auditorium.

Wednesday morning the man from Bell wrote his secret down on the bottom half of an overhead transparency, covered it with a piece of paper, and invited Adleman to write his solution on the top half. They projected the transparency onto the auditorium screen in view of all the mathematicians. The two keys matched.

Now that Graham/Shamir is broken, most cryptographers agree that only one usable public-key encryption method remains. It is called the RSA technique after its inventors, M.I.T. computer science professor Ronald Rivest, together with the same Adi Shamir who coinvented Graham/Shamir, and the Leonard Adleman who successfully challenged it.

A lot of organizations would like to use public-key encryption because it doesn't entail giving out secret codes, but many people are wary. Blake Greenley, vice-president of Citibank, says he would use an encryption method only if "it has been set up on a pedestal and shot at" by government agencies—and afterward certified.

Last June 30, in the Federal Register, the National Bureau

ILLUSTRATIONS: JON MCINTOSH

of Standards (NBS) requested cryptographers to submit public-key methods for scrutiny and certification. Some cryptographers were reluctant to comply because they feel that the NBS, together with the NSA, may have compromised the security of the non-public-key encryption method known as the Data Encryption Standard when they certified it. But now that RSA is the only remaining public-key method, the inventors have decided to submit it—four days before the September 27 deadline. Whether it will survive this or other tests is anyone's guess.

To make RSA sound, its coinventor Adleman says, "We tied it to a problem with an awesome history of mathematicians' trying without success to solve it"—the high-speed factoring of large numbers into primes. For example, 15 can be factored rapidly into 5 times 3, which are primes because they can't be expressed as products of smaller whole numbers. But try factoring 1,356,467,867,655,667,359,857—there is no easy way. Unfortunately, there is no guarantee that someone playing with a home computer won't come up with a quick method to factor large numbers tomorrow.

Cryptographers can probably find other good public-key systems, Adleman says. "But there are good reasons in principle why it is difficult to come up with them." For one, "you will never be able to get a mathematical proof" that a system is secure. So, as the participants in the Crypto '82 Conference well know, cryptographers cannot fall asleep at night with the confidence that next morning their public-key ciphers will still be secure.—*Carolyn Meinel* □

Clean Nuclear Power?

A growing community of physicists believe it may be possible to develop a type of nuclear power that does not require radioactive fuel and does not produce radioactive waste. Unlike today's fission plants or the fusion plants generally promoted by government-sponsored research, a nuclear power plant of this sort could not be converted to an atomic bomb factory.

Nearly all the troubles of nuclear power are due to neutrons, the uncharged particles that, together with positively charged protons and negatively charged electrons, make up atoms. Neutrons are necessary to most nuclear reactions. When atoms such as uranium split in existing fission reactors, they release neutrons, which strike other uranium atoms to continue the chain. Similarly, in standard fusion reactions, neutrons carry forward the chain reaction that combines two types of hydrogen atoms—deuterium and tritium—to release energy.

In both these reactions, neutrons slam into and combine with nuclei of nearby atoms, making them heavier, unstable, and radioactive. This process produces radioactive waste, deteriorates the structures of reactors, and must be separated from humans by massive shielding. Finally, energetic neutrons are capable of converting relatively harmless substances such as natural uranium into the stuff of atom bombs.

But physicists have long known that nuclear reactions involving certain atoms do not produce neutrons. For example, when boron atoms (found in common borax) are hit by positively charged protons, they split and release energy. This and some other reactions, including proton-lithium encounters, are carried forward by protons, not neutrons. Since positively charged protons are repelled by the other protons in atoms' nuclei (like charges repel), they do not readily attach themselves to cause radioactivity. Proton-based reactions might produce a few neutrons but would be essentially clean.

The question is how to ignite proton-based chain reactions. They largely fuel stars, but until recently most physicists have considered them unthinkable as a power source on earth. While the standard deuterium-tritium, or DT, fusion requires a mere 100 million degrees centigrade to produce useful energy, proton-based reactions require 10 billion degrees. And nobody has yet produced energy from standard fusion. Only a few years ago Bruno Coppi, a physics professor at M.I.T., wrote that proton-based fuels would not merit serious study in this century.

Developments since then have convinced Coppi to change his mind. He himself has been responsible for some of these, but perhaps the most suggestive ideas have come from Bogdan Maglich, a former physics professor at Rutgers and senior researcher at the European Organization for Nuclear Research, now working at Aneutronic Energy Labs in Princeton, N.J.

In Maglich's scheme, as in standard fusion reactors, atoms must combine for an instant before splitting to release energy. Since nuclei are positively charged, they repel each other. Only if they are moving fast enough can their energy overcome that mutual repulsion and bring them together.

In standard DT fusion schemes, the positively charged deuterium and tritium nuclei—having lost their orbiting electrons owing to the high temperature—shoot about randomly, much like molecules at ordinary temperatures in a gas. But since physicists cannot yet create such a plasma hot

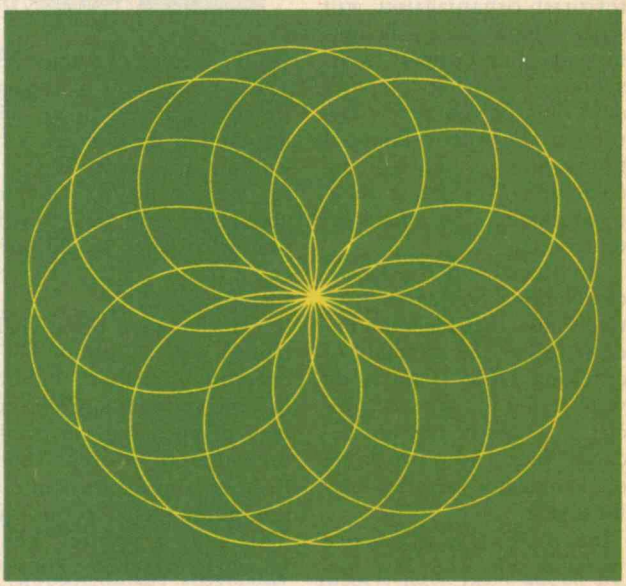


DIAGRAM: OMNIGRAPHICS

enough (in which particles are moving fast enough) to ignite ordinary fusion, they see little hope of igniting even hotter proton-based reactions.

That is why Maglich has taken another tack. He hopes to make highly energetic beams of particles, such as those produced by atomic accelerators, collide and fuse. Unfortunately, the beams tend to scatter before the particles fuse—physics books claim that fusion cannot be achieved with beams, says Maglich. He believes he will prove the physics books wrong. Lawrence Lidsky, an M.I.T. professor of nuclear engineering who helped evaluate Maglich's work for the former U.S. Energy Research and Development Administration, isn't guaranteeing success, but he says particle beams are clearly the most promising way to ignite proton-based reactions.

Maglich's scheme involves configuring particle beams of lithium, boron, and hydrogen nuclei in a pattern that could be compared to an imaginary flower. A particle orbits in a circle, corresponding to the edge of a perfectly round petal. When the particle comes to the center of the flower—in effect the stem—it may hit another particle orbiting around another petal. The important thing is that the two particles do not go off in utter abandon. The laws of motion dictate that both must orbit off around other petals and again come back to the center of the flower. The flower of orbiting particle beams—Maglich calls it a "migma," Greek for mixture—does not scatter randomly. He hopes to increase the speed of the particles, their density, and the length of time they stay in the migma, until the collisions at the center produce a nuclear reaction.

He says he can produce energy from proton-based reactions in his laboratory within five years, and he believes he can eventually build a power plant not much bigger than a home furnace.

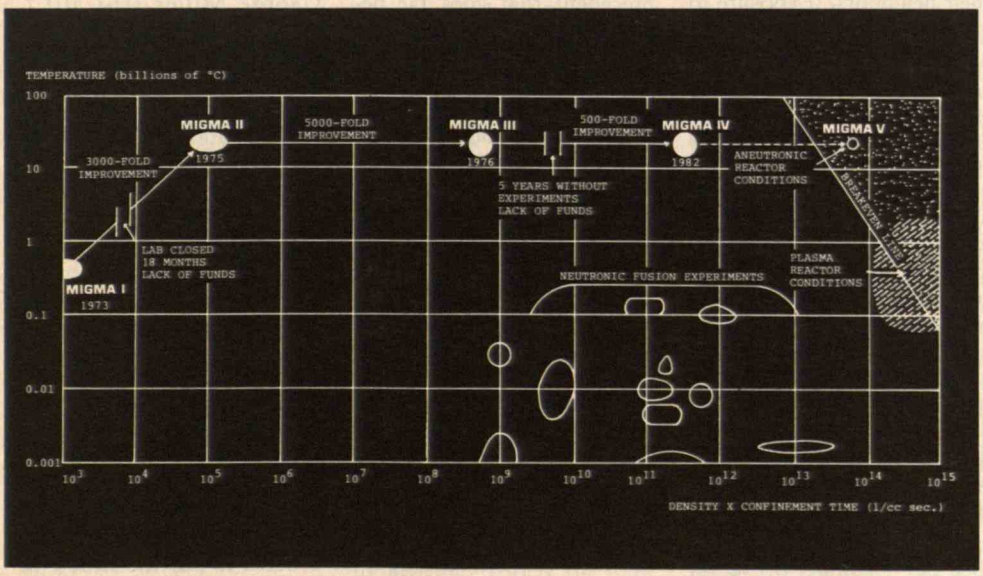
James F. Decker, director of the Division of Applied Plasma Physics at the U.S. Department of Energy, agrees that proton-based reactions are possible in principle, but he doubts they can work in practice. They require large amounts of energy to ignite, and calculations based on fundamental physical laws show that much of the energy they produce must be wasted. Considering the additional waste that will inevitably occur in practice, Decker says the net energy you get out is "highly marginal."

Though Martin Deutsch, professor of physics at M.I.T., does not share Maglich's enthusiasm about the five-year time schedule, he says, "Even mainstream fusion people are beginning to take high-energy injection of particle beams seriously, and Bogdan certainly was the guy who pioneered it."

Like his colleague Lidsky, Deutsch is convinced that to achieve a clean proton-based reaction, you must start with particle beams, as Maglich has. But you must produce atomic collisions, and even Maglich's migma begins to break down as it approaches the extreme conditions required for a reaction. "The question is," Deutsch says, "will enough reactions take place before the beams become chaotic?"

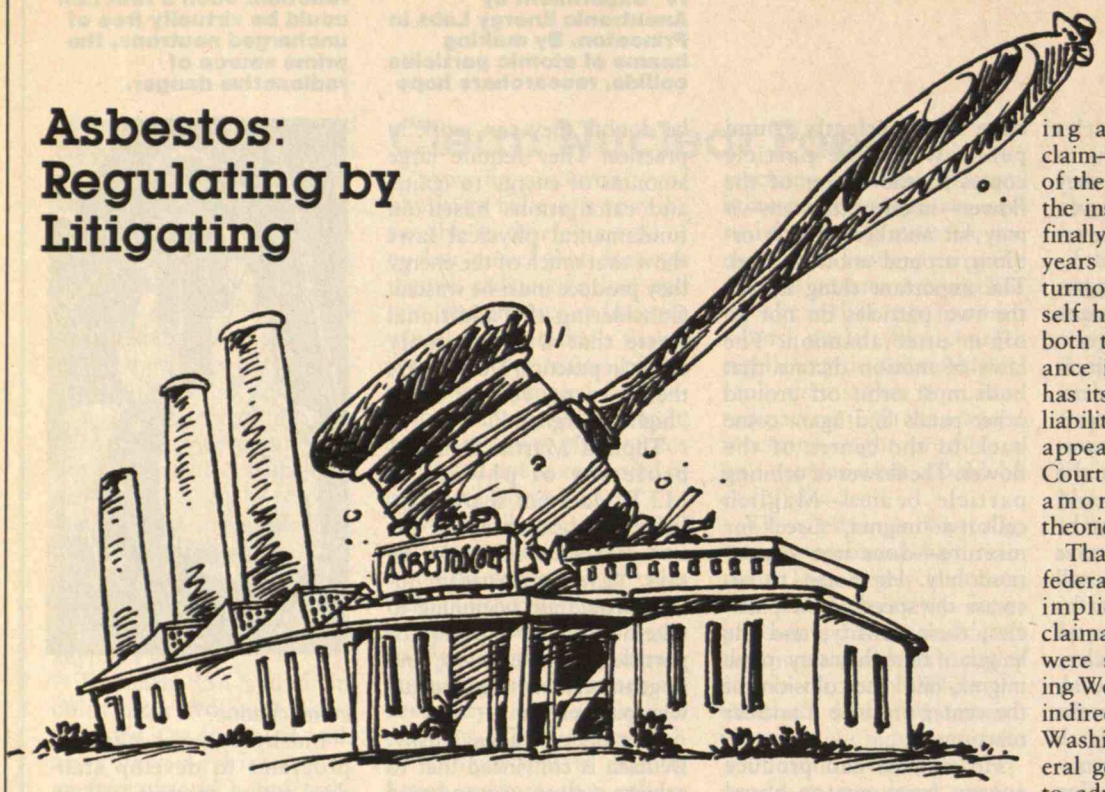
Lidsky believes national programs to develop standard fusion reactors will result, at best, in a nuclear Concorde—mammoth and uneconomical. "We have been following one path," he wrote last March for the National Science Foundation. "Although we have made enormous progress, the path ends in a thicket. Success *may* come faster on another road."—*J.S.* □

Equipment for the "Migma IV" experiment by Aneutronic Energy Labs in Princeton. By making beams of atomic particles collide, researchers hope to ignite a nuclear reaction. Such a reaction could be virtually free of uncharged neutrons, the prime source of radioactive danger.



A "migma" (far left), a flowerlike pattern of orbiting particle beams. Aneutronic Energy Labs hopes to create a migma in which particles have enough energy, at a sufficient density, and for a long enough time to ignite nuclear reactions that release useful energy. Progress toward these conditions is depicted in the chart (left).

Asbestos: Regulating by Litigating



"It is no exaggeration," said Ray Marshall, secretary of labor under Jimmy Carter, "that virtually every piece of safety, health, or worker's-compensation legislation was enacted after a major disaster." Unfortunately, most occupational illnesses, being subtle and long-term, are not perceived as major disasters and therefore provide few incentives for action. "The individual victims often die quietly, many years after the workplace exposure," said Marshall.

Yet the prerequisite major disaster in occupational illness may well be shaping up. Ironically, it could be an *economic* disaster that prompts the needed reform in compensating, treating, and preventing occupational disease.

The Manville Corp. of Denver, Colo., one of the world's leading producers of asbestos, is the most prominent case. Manville filed last August for reorganization under Chapter 11 of the Federal Bankruptcy Act. The reason was not the routine one; Manville was a solvent company. It declared bankruptcy in response to the prodigious number of damage claims—some 16,500 at the time, with the number increasing at the rate of 500 per month—by former Manville employees, customers' employees, their families, and their neighbors. (Exposure to asbestos need not be direct, and a little goes a long way. It causes mesothelioma—an ordinarily rare form of lung cancer—and other serious respiratory diseases.)

Manville was far from alone—some 30,000 claims have been filed against 260 asbestos firms—but when a consultant, Epidemiology Resources of Brookline, Mass., advised Manville that the number of claims against the firm might eventually reach 52,000 and cost $2 billion, draconian measures seemed warranted. "We are completely overwhelmed," said John A. McKinney, Manville's president, in filing for reorganization—a step that automatically froze current litigation and precluded any new cases from being filed against the company.

Manville's action may induce other asbestos firms to follow suit (UNR Industries, a Chicago-based firm, was actually the first, in July), but it may also help establish a precedent that goes far beyond the asbestos industry. This is because many other types of occupational exposure to chemicals are similar in their cause-and-effect patterns. Damage claims and punitive awards due to company negligence could drive more than a few firms out of business.

A complicating factor is the finger pointing, name-calling, and suits and countersuits that have provided at least temporary relief to all parties except the injured themselves. Consider, for example, the insurance industry and its "bad faith," as Manville's McKinney puts it. The issue of who is responsible for paying an asbestos-related claim—the insurer at the time of the worker's exposure, or the insurer when the disease finally manifests itself many years later—has resulted in turmoil. The legal system itself has been criticized by both the asbestos and insurance industries. Each state has its own interpretation of liability, as does each court of appeals, and the Supreme Court has refused to decide among the conflicting theories and approaches.

That perennial target, the federal government, is also implicated. Many of the claimants in asbestos cases were shipyard workers during World War II—directly or indirectly in the employ of Washington—and "the federal government has refused to admit its responsibility," says McKinney. But according to many of the attorneys representing former asbestos workers, Manville's laments are an attempt to intimidate the federal government into bailing the company out. In any event, no such response from Washington appears imminent. The only serious initiative, sponsored by George Miller (D-Calif.), chairman of the House Subcommittee on Labor Standards, would require the asbestos industry to set up a compensation fund *without* benefit of federal money.

What dilutes the asbestos industry's arguments for federal aid is the fact that claimants are not merely being granted compensation by the courts. In many cases, they are being awarded punitive damages as well: the courts have decided that management has sometimes knowingly exposed workers to asbestos hazards. In a case against Manville last May in Cleveland, the company was ordered to pay the widow of

ILLUSTRATION: JON MCINTOSH

an asbestos worker $850,000—of which $500,000 was punitive.

"The civil suit seeking damages," says William Shernoff, president of the California Trial Lawyers' Association, "is the most efficient weapon available to most citizens against wrongful acts by unregulated industries. [It is] a nonbureaucratic, free-enterprise method of providing protection." The threat of such nonregulatory sticks, in light of the large and growing number of asbestos claims and the sympathy of the courts, may well convince industries to take preventive measures more seriously. If so, the approach could preclude such suits altogether and succeed where "command-and-control" regulation has often failed.

A great deal depends on whether the asbestos case can be generalized to include other workplace chemicals. Asbestos produces illnesses clearly associated with it alone, but most other occupational effects are not so easily correlated with single causes.

Even with asbestos there is more talk than action. Professor Irving J. Selikoff, a prominent researcher on asbestos-related disease, recently contrasted the hoopla on compensating such deaths with the "meager efforts" at preventing them. He wrote in the *New York Times* that "there is little medical surveillance for early diagnosis and treatment, few programs to explain the risk of smoking for those exposed to asbestos, and very little research to develop better means of treatment." But to be truly effective, the court cases must prompt companies to go beyond treatment and prevent disease in the first place.—*S.J.M.* □

Revamping Drug Approval

Last summer Oraflex, an arthritis drug, had to be pulled off the market only four months after the Food and Drug Administration (FDA) had approved it. Dr. Robert Temple, acting director of the FDA's Office of New Drug Evaluation, said the medication was connected with 11 deaths in the United States and 61 in England, where it had been used for two years.

"It's pretty clear that the review (of Oraflex) was sloppy," says Daniel Sigelman, a staff researcher with the House Subcommittee on Intergovernmental Relations and Human Resources. He found that reviewers at the FDA were apparently unaware that the agency's own documents reported the drug's harmful side effects.

The problem, according to Christopher Smith at the FDA, is that reviews are divided into an investigational stage and a new-drug application stage. The developer of Oraflex, Eli Lilly & Co., reported the drug's side effects—principally jaundice—to FDA administrators involved in the investigational stage, but that information, Smith concedes, "didn't get to the people overseeing the new-drug applications."

Despite the Oraflex controversy, the Reagan administration is pressing ahead with proposals that it says will speed up the drug approval process—but not weaken it. Richard Schweiker, secretary of the Department of Health and Human Services, recommended last June that companies no longer be required to provide reports on individual patients on whom drugs are tested, eliminating 70 percent of the paperwork. Instead, the FDA would use data tabulated from the reports and also rely on a broader range of drug trials done in foreign countries.

At the same time, Schweiker wants to tighten the requirements that a manufacturer report harmful side effects discovered after a drug is approved. Smith says that changing these procedures would reduce the time it takes to approve a new drug from 24 months to 18.

The House subcommittee is critical of Schweiker's proposals. Sigelman says the most disturbing one is to drop the requirement that manufacturers submit case reports on individual patients. "Tabulations tell you very little," he says, because there is no way to check whether they are properly based on the facts.

FDA officials say it is precisely the tabulations that they work from, and besides, if the reviewers have questions, they will still be able to request case reports. But Sigelman believes this will only slow drug approvals: "If the reviewer decided he needed case-report forms that weren't submitted, he'd notify the company and wait for them. Right now he's got the case report forms in house."

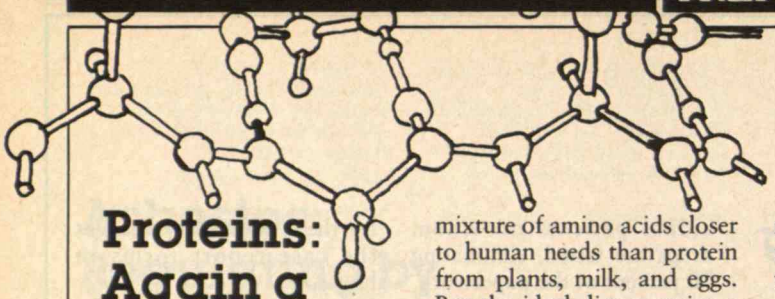
As for the idea that the FDA should rely more on foreign studies, Sigelman says foreign data are more difficult to evaluate and often inferior to American data.

Smith says the FDA would accept foreign data only from reputable researchers, as in the case of timolol, approved last year to prevent heart attacks on the basis of a Norwegian study. He says it would have been unethical to require further study in this country and thereby stop patients from using the drug, when it worked so well.

But Dr. Sidney Wolfe, director of the Health Research Group, which he founded with Ralph Nader, doubts that Schweiker's proposals will benefit the public as much as the drug companies. "The FDA brags about approving 27 new drugs last year," he says. "But from the consumer's standpoint it's no big deal because most of them are duplicates. There were three drugs in the same family as Valium approved last year. We really don't need any more of those." A persistent critic of the FDA, Wolfe petitioned the agency several times to ban Oraflex, and was largely responsible for alerting the FDA to the deaths related to that drug in England.

The Lancet, the respected British medical journal, concluded in a recent editorial that British doctors should have been more cautious in prescribing Oraflex. "What we really need is an improvement in the standard of prescribing drugs," *The Lancet* concluded. It is a piece of advice worth repeating on this side of the Atlantic.—*Paul Raeburn* □

ILLUSTRATION: SUSAN FALLOWS



Proteins: Again a Deficit

Early in 1983 the World Health Organization and the U.N. Food and Agriculture Organization will increase the minimum amount of protein recommended for human diets by at least a third, raising once more the spectre of a world protein crisis. That problem seemed to vanish a decade ago, when the protein need recommended by the WHO/FAO was sharply—but incorrectly—reduced, Professor Nevin S. Scrimshaw of M.I.T. told the American Chemical Society last fall.

Though proteins have been recognized as essential nutrients for well over a century, the uncertainty about how much humans need has been a real issue—scientific, not political—said Dr. Scrimshaw. The controversy arises because of the many different roles and forms—"hundreds of different configurations"—of proteins in human nutrition.

Proteins are constructed of some 20 different amino acids, more than half of which can be synthesized in the body. The dietary protein requirement thus includes two amino acid requirements: enough of the eight so-called "essential" amino acids—those that cannot be synthesized—to meet nutritional needs, and enough amino acids in general so the body can synthesize adequate amounts of the rest. If not needed for their amino-acid content, proteins are utilized as a source of calories—the energy we use while working and playing.

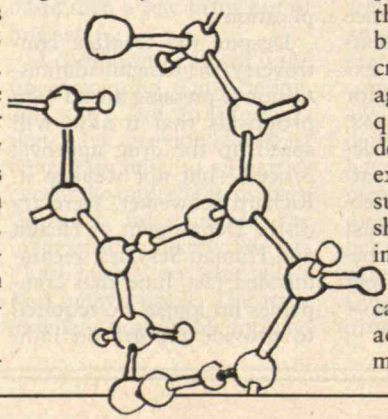
The single best source of protein for humans is meat, says Dr. Scrimshaw. It has a mixture of amino acids closer to human needs than protein from plants, milk, and eggs. But the ideal diet contains a combination of many animal and plant proteins to assure a broad mixture of amino acids. It is this complicated pattern of protein utilization that makes setting a dietary requirement so difficult and so controversial, said Dr. Scrimshaw.

Disturbed by the low protein requirements set by the FAO/WHO in the 1973 report, he asked student volunteers to take part in a nutrition experiment: What would happen to healthy males whose protein intake was limited to the 0.57 grams per day per kilogram of body weight in the new guideline? After three months the students were losing weight on this spartan diet, and some showed abnormal blood characteristics. On the other hand, studies in other parts of the world failed to produce similar results, suggesting that the FAO/WHO figure was close to the mark. The difference, it turned out, was due to the digestability of different proteins—depending both on the protein source and the particular person—and due also to humans' different protein requirements—depending on their age and the amount of energy they expend.

In addition, a special characteristic of protein demand in young children was not factored into the 1973 dietary recommendation. Children stay the same size for periods of a few weeks or months and then catch up by growing at two to four times the daily average. When growth actually occurs, Dr. Scrimshaw said, children require 36 percent more protein than the average annual demand.

The 1973 protein recommendations turn out to provide inadequate energy as well as amino acids. This aspect of protein difficiency does not show up in health statistics. It's revealed more subtly, according to Dr. Scrimshaw, in terms of too low a basal metabolic rate for "productive economic activities or long-term maintenance of health." Such effects have been documented in studies of Guatamalan plantation workers who "virtually collapse" at the end of a short work day because of protein deprivation, he said. The World Health Organization estimates that at least 500 million children in developing countries become stunted as a result of protein or caloric deficiencies, and Professor Scrimshaw believes that many more show a reduced interaction with their environment—and hence "poor cognitive performance"—from protein deficiencies.

Next year's FAO/WHO report, said Dr. Scrimshaw, will probably specify that protein should constitute 10 to 12 percent of total caloric intake, compared with 4 to 5 percent in the 1973 standards—a difference that is "by no means trivial." The result will be renewed concern for how to meet the large future protein demands implied by today's rapid worldwide population growth.—*J.M.* □



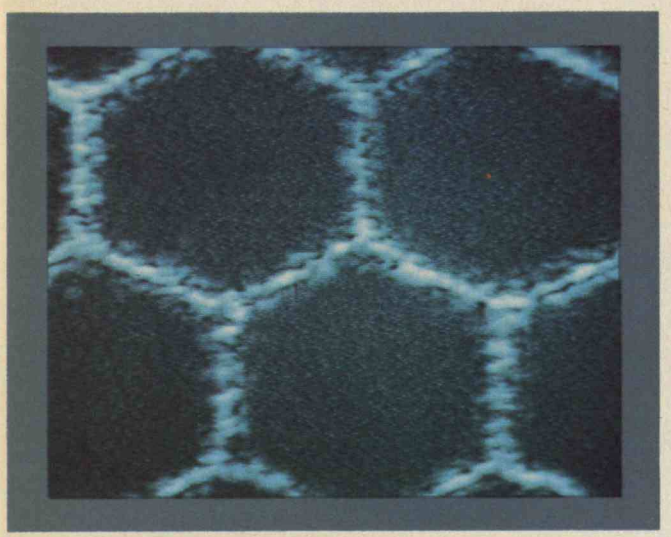
Acoustic Microscopes

To some, the word "microscope" calls to mind the standard device biology students squint through. Others are familiar with the electron microscope that reveals the remarkable molecular world at high magnifications on a video screen. But a new breed—the acoustic microscope—has recently appeared. It sends high-frequency sound waves through specimens—even if they are as opaque to light as steel—and, like the electron microscope, uses video to display what it discovers.

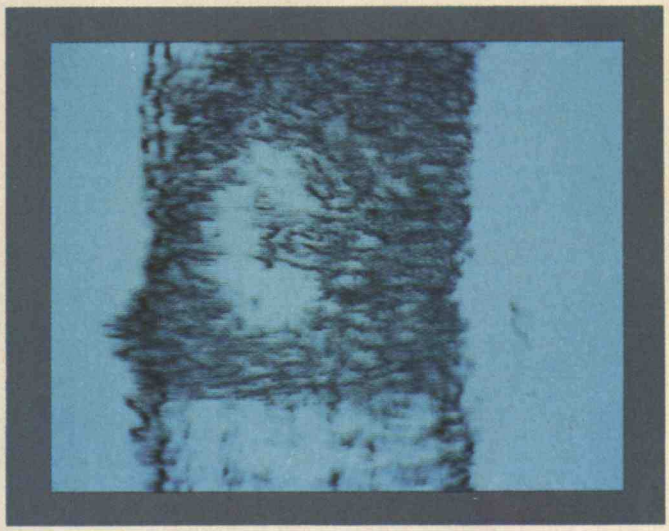
The SLAM, short for scanning laser acoustic microscope, is so far the most versatile of this new breed. It uses the fact that sound has different velocities in different materials—traveling about 1,000 feet per second in air but almost 30 times as fast through diamond, for example—to create an image in much the same way as the ultrasonic scanners used in hospitals for several years.

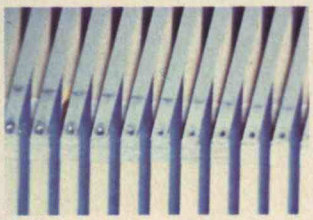
But hospital scanners use ultrasound of a much lower frequency—around 2 megahertz, or 2 million cycles per second—while the SLAM's ultrasound ranges from 10 to 500 megahertz. The hospital scanners' low frequency penetrates deep—it can travel through the human body—but the relatively long waves create a somewhat fuzzy image. The SLAM's higher frequencies penetrate less deep—up to six inches in an excellent sound transmitter such as aluminum—but the short waves produce a sharp image.

An acoustic microscope called the SAM, or scanning acoustic microscope, to be made by the Olympus Corp.



A reflective two-layer plastic used in street signs. The two layers are bonded along hexagonal lines (below). In the acoustic-microscope photograph (above), the lines are light, because the solid bonds transmit sound well.





A mechanical part used in computer card-sorting mechanisms. Note tiny spot welds (below). The light-shaded oval in the acoustic-microscope photograph (above) shows that this weld is good, except perhaps in the dark spot at the center.

uses ultrasound at even higher frequencies, producing a sharper picture. And next year the Leitz Corp. plans to make a similar device. But the SAM is essentially a surface instrument: Olympus claims only that its microscope penetrates 150 microns. Also, because of the way the SAM works, all specimens have to be flat, so the chief application so far is in inspecting silicon chips.

By contrast, in the past two years the SLAM has been used to examine hundreds of materials. Manufacturers have employed the acoustic microscope to detect flaws in products, and researchers have begun using it in fields ranging from ceramics to zoology.

Biologists have found relatively few applications for the acoustic microscope so far, but I recently spent a few hours looking through one at standard specimens such as one-celled paramecia, vinegar eels, and algae. Although I am an experienced photomicrographer—experienced at taking photographs through microscopes—I found that it takes some practice to interpret images created by sound waves rather than light.

At first I couldn't see a blue-green alga on the acoustic screen at all, probably because its acoustic properties are very similar to those of the water it was immersed in. But as I bled off the water, the alga gradually appeared. Looking at vinegar eels, I saw a great deal of fatty tissue, which is acoustically dark because it transmits ultrasound poorly. The paramecium showed up clearly and appeared healthy but immobilized, possibly paralyzed by ultrasound.

Dr. Lawrence W. Kessler, president of Sonoscan, the Illinois firm that makes the SLAM, says its increasing use in industry stems from concern about product quality. The SLAM can be used to check for welding flaws in products ranging from ordinary "tin" cans (which are actually made of steel) to the leads of the solar cells. Even a microscopic crack in the weld shows up on the acoustic screen as a dark area because air transmits almost no ultrasound, while steel is a good transmitter.

A skilled operator can use a SLAM to check the bonds in a two-part turbine blade for a jet aircraft. This operation takes a full minute, but the SLAM can check as many as 10,000 simpler objects, such as capacitors, in an hour with automated equipment. The acoustic microscope can also detect a tiny foreign inclusion, such as an iron particle in a ceramic material. By examining the specimen from different angles, the operator can measure the depth of the inclusion.

To use the SLAM, you put any object you want to examine on a viewing "stage" and place a plastic coverslip on top. Ultrasound beamed from below travels through the specimen and sets up minute ripples in a thin layer of gold on the coverslip. A laser beam scans across the gold layer and reflects changes in the ripples' angles. A photodiode—an electronic component that transmits a current proportional to the light it receives—detects the reflected beam. This information is processed to produce the image on the video screen. A second photodiode on the SLAM collects light directly from the specimen, and this is processed to create an optical image on another video screen.—*Tom Adams* □

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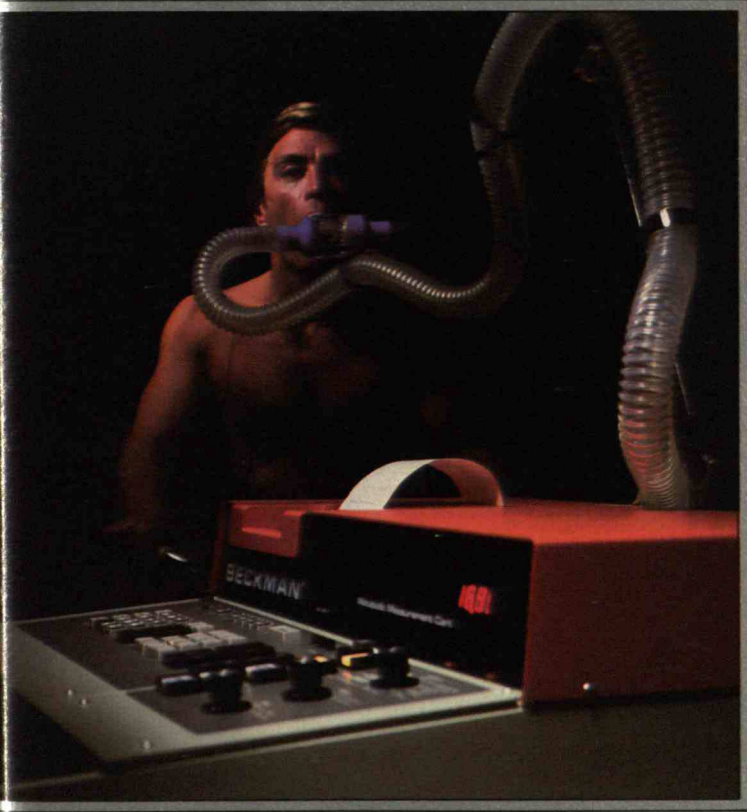

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The extraordinary diamond solitaire. When a man's achievement becomes a woman's good fortune.

A diamond is forever. De Beers

COMETS/ROBERT COWEN

(Continued from page 6)

could have passed close to Earth, with fragments of it hitting. This kind of event, they say, is reflected in ancient writings.

This is heady stuff. But it is nowhere near as far out as the Hoyle-Wickramasinghe theory, which has taken on religious overtones. These scientists began their theory as an effort to understand interstellar dust. This led them first to conclude that the dust contains complex organic molecules, then that it contains living cells and consists partly of the remains of bacteria, and finally that comets harbor such space-born life forms.

As they developed their theory, Hoyle and Wickramasinghe suggested that genetic material, viruses, and bacteria seeded life on Earth, and that debris from passing comets settled through the atmosphere. They have expanded this thesis to suggest that such living debris continues to sift down. They attribute major evolutionary steps to virus-borne genetic instructions that reprogram life forms for new roles. They regard this as a better explanation of the fossil record, with its celebrated gaps, than traditional Darwinian evolution through natural selection of existing gene pools. They also propose that some of this incoming material causes diseases and major epidemics.

Finally, since the whole grand scheme seems to have purpose and intelligence behind it, Drs. Hoyle and Wickramasinghe conclude that a higher intelligence is indeed involved. As Martin Gardner pointed out in *Discover* last March, "Their argument is a mathematically sophisticated form of the ancient proof of God by design." The publisher quotes this on the book jacket as though it were a statement of approbation. But Gardner meant it as a put-down.

From the scientific point of view, this is wild stuff—far wilder than anything Velikovsky proposed, apart form his unworkable astronomical mechanisms. The Hoyle-Wickramasinghe theory avoids that sort of trap by leaving any necessary miracles to a higher intelligence. Among other things, their line of thinking has produced the bizarre spectacle of Wickramasinghe testifying for the defense in the Arkansas creationist law trial a year ago. However, he let his sponsors down by saying that his belief in a higher intelligence did not predispose him toward a literal interpretation of the Genesis myth.

So far, the scientific establishment has treated the Hoyle-Wickramasinghe theory with polite skepticism. The ideas of Clube and Napier have not been in circulation long enough to have stirred much comment. But the efforts of leading scientists 30 years ago to suppress Velikovsky's first book, as well as the condemnation they heaped on him, have been conspicuously lacking this time. The scientific establishment is more tolerant these days, having learned how counter-productive such actions can be. But it is hard to escape the conclusion that heretics within the fold are treated differently than a provocative layman perceived as threatening the authority of science in the public eye. □

PROPERTY/KENNETH BOULDING

(Continued from page 11)

really do not understand them very well. Why are some things regarded as legitimate, such as national defense, which can only make everybody worse off? And why, on a much smaller scale, do we regard interest rates as legitimate when they can be very destructive? Yet we are slow to recognize the legitimacy of integrative structures that give rise to stable peace, human decency, and even stable property.

Property is perhaps one of the greatest of all human inventions. Properly managed and defined, it leads constantly to positive-sum games in which everybody becomes better off. It permits variety in personal life and culture to develop, as well as individual creativity and social mutation. It goes as far back in evolution as the development of skin, enclosing an organism in a kind of household—a little kingdom of internal order, separated from the wild world without. Nevertheless, like everything else, it can go wrong. I know of no system that does not have pathologies. One of the great tasks of the human race is to identify the pathologies of property and correct them, so that it can fulfill its enormously creative function.

One development that could move us toward a solution to this problem is the increased consciousness of the "integrative system," as I have called it. Legitimacy is an extremely important component of this, which in turn depends on the structures of friendship and enmity. We still face the problem that 6 percent of the world's resources are devoted to national defense organizations, whose business is enmity. This is the deepest pathology in the world system.

We tend to take the structure of friendship and enmity as given, whereas in fact it is the result of innumerable human acts in a dynamic process. If the agenda for reaching every decision included an item for discussing how much friendship and enmity it would create, decisions might be very different. For instance, the Falkland Islands tragedy, or the much greater tragedy of Lebanon, might not have occurred. □

Exploring Our Limits on Earth and at Sea

Muzzling the Monster

The Fate of the Earth
by Jonathan Schell
Alfred A. Knopf, 1982, $11.95

Reviewed by Michael Riordan

The American political landscape has witnessed the appearance of frequent mass movements that spring up to confront the contradictions of our society. These movements generally focus on one or two specific issues—civil rights, the Vietnam War, and the environment being the most recent examples. Mass movements have been a particularly effective way for certain segments of this large, pluralistic, seemingly democratic society to bring about meaningful change when its leadership was deaf to their demands.

After the events of this past spring, it appears likely that nuclear war and disarmament have finally become enduring public issues worthy of their own mass movements. It is difficult to dismiss lightly the 750,000 people who gathered in New York's Central Park last June. Nor can one ignore the current outpouring from writers who bring these issues—once almost exclusively the domain of government insiders—squarely into the arena of public discourse. The movement against nuclear war shows every sign of continuing its rapid growth and maintaining its influence.

Now that this movement seems to be on a solid footing, a critical examination of its literature—particularly *The Fate of the Earth*, by Jonathan Schell—is in order. Called by many the bible of the movement, this book has been compared with Rachel Carson's *Silent Spring* and Harriet Beecher Stowe's *Uncle Tom's Cabin*. It has attracted the praise and endorsement of virtually every liberal pundit on the political map. The publisher even claims that the book may someday be considered "a crucial event in the history of human thought." In seeming affirmation of these plaudits, the book has spent a few months near the top of every national bestseller list.

The Fate of the Earth is divided into three long chapters corresponding to three articles that appeared last February in the pages of *The New Yorker*. In the first chapter, Schell eloquently describes the probable human consequences of a nuclear holocaust, concluding that the extinction of humanity and most other complex life forms is distinctly possible, even probable. In the second, he ponders the meaning of extinction at great length and urges his readers to break free of the mental stupor induced by this horrible prospect. In the final chapter, he confronts the doctrine of nuclear deterrence and concludes that national sovereignty is a political principle no longer useful in a world dominated by thermonuclear weaponry.

The first chapter is by far the best and most forceful of the three. Here Schell relates what has for years been common knowledge among strategic planners and concerned nuclear physicists but only dimly perceived, if at all, by the general public. He speaks, however, not in the language of kilotons and megadeaths but in metaphors characteristic of literature. He describes the true horror of a nuclear holocaust—its effects near ground-zero and its consequences for rural "survivors." Here lies Schell's most important contribution. He has stared unblinkingly into the jaws of the monster and returned to awaken people to the impending danger. They would never have listened to him had he come back speaking the monster's tongue.

Unfortunately, this first chapter contains a few basic flaws in logic, one of which has already been seized upon by a number of the book's detractors: Schell gathers his arguments only around "worst-case" scenarios of nuclear warfare. For example, he describes the effects of a 20-megaton warhead on New York City, while the Soviet arsenal consists predominantly of warheads of only one or a few megatons. He then cites the example provided by M.I.T. physicist Henry Kendall, chairman of the Union of Concerned Scientists, of a massive nuclear attack, wherein the *entire* Soviet arsenal is used against American military, industrial, and civilian targets. He assumes the worst for the earth's ozone layer, its complete breakdown by oxides of nitrogen is the final ecological insult that will lead to the extinction of the few surviving pockets of humanity, leaving a "republic of insects and grass."

More moderate analysts assume that both the Soviet Union and the United States would hold substantial portions of their arsenals in reserve in any "exchange," and that a fair fraction of the warheads sent would be off target or fail to detonate properly. Predictions of ecological effects, though subject to large uncertainties, do indicate that the ozone layer would be severely damaged, with perhaps half the normal amount of ozone depleted, but that it would be slowly replenished. According to these analyses, many, if not most, complex species would probably survive. Given the adaptability of the human species, small pockets of humanity would almost certainly survive, particularly in rural areas and in the Southern Hemisphere.

I do not mean to imply that the consequences of nuclear warfare are not completely unbearable and deplorable. A massive exchange would almost certainly wipe out many hundreds of millions of people and precipitate the collapse of the urban culture we equate with modernity. But the possibility of human extinction, upon which most of Schell's remaining two chapters rely, is based on suspect arguments. He could have made a convincing case against nuclear war without invoking this spectre. Seen in this light, the second chapter of *The Fate of the Earth* is exceedingly tedious reading. Schell takes over 80 repetitive pages in attempting to analyze the meaning of extinction; he never quite succeeds.

Finally, I find Schell's political analysis somewhat naive. Again, the problem has its roots in his otherwise excellent first chapter, where he seems to accept the existence of nuclear weapons as the inevitable byproduct of modern technology—their possibility is guaranteed by the laws of physics; so, sooner or later, he says, advanced civilizations are going to stumble upon ways to manufacture them.

But he ignores the clear fact that nuclear

ILLUSTRATIONS: IRENA ROMAN

weapons did not appear in our midst spontaneously—as the accidental discovery of some lone scientist working long hours in a laboratory. Rather, the weapons were intentionally created for explicitly *political* reasons. It took billions of dollars and the sequestering of hundreds of the nation's finest scientists for years before the first crude atomic bomb could be developed at Los Alamos. Many more years and *hundreds* of billions of dollars were required to produce modern thermonuclear weapons and their ballistic-missile delivery systems. Without these tremendous projects, we would have no nuclear arsenals.

It is this ability of modern superstates to amass enormous funds, and to spend them on projects of a scale unknown before World War II, that makes all-out nuclear warfare possible. Lesser powers such as Britain, France, India, and China have nuclear weapons but cannot pose anywhere near the same threat to humanity as the United States and the Soviet Union. The overwhelming tendency in this century for countries to move toward more and more powerful, centralized forms of political organization is at the root of our current nuclear dilemma. Nuclear weapons must be seen as the inevitable result of this tendency, not as the unfortunate by-product of modern science and technology. They are *political* artifacts.

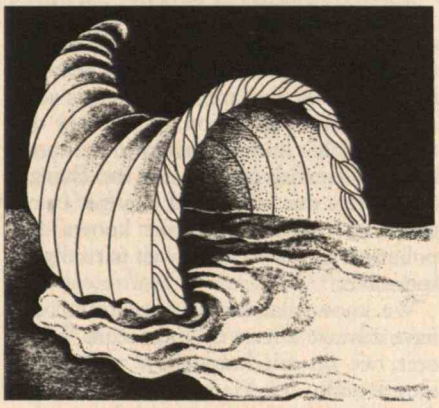
To his credit, Schell perceives that finding a true and lasting solution to the current nuclear dilemma requires fundamental changes in the world's political organizations. In the final chapter, he argues that we must now transcend the present system of national sovereignty and the use of warfare to settle disputes: "Our present history and the institutions that make it up are the debris of history. They have become inimical to life and must be swept away. They constitute a noose around the neck of mankind, threatening to choke off the human future, but we can cut the noose and break free."

Schell calls for complete disarmament and the establishment of a global political organization capable of resolving disputes without recourse to violence. Just how the world might achieve disarmament and what this global organization would look like are matters left for other thinkers and writers.

Although I agree with Schell's observation that the present system of sovereign nation-states is fundamentally obsolete, I question whether a global world order is the only possible solution to our nuclear dilemma. Did not these nuclear weapons arise as an indirect result of people surrendering their power to centralized national authorities? Do we solve the problem by creating institutions even more remote from the individual? I think not. A true solution must also allow people to recover the power they once surrendered to national governments.

Whatever final solutions advocated, the various popular movements against nuclear war find themselves on fundamentally new terrain. This time they are not just petitioning a single government to redress a few particular grievances—they are questioning the very validity of soverign national governments. And like the effects of the nuclear weapons they decry, these movements will have to transcend national boundaries if they are to have any lasting effect. □

Michael Riordan is coauthor of The Solar Home Book *and editor of* The Day after Midnight: The Effects of Nuclear War. *He holds a Ph.D. in physics from M.I.T. and works as editor and publisher of Cheshire Books.*



Debunking the Myth of the "Inexhaustible" Ocean

The Oceans: Our Last Resource
by Wesley Marx
Sierra Club Books, 1981, $13.95

Reviewed by Robert W. Howarth

During the last two decades people have begun to recognize the limits of marine resources. Yet to many the oceans still seem to represent a wealth of unexploited bounty—fish, minerals, oil, and an infinite expanse of water to assimilate wastes. The title of Wesley Marx's book, *The Oceans: Our Last Resource*, seems at first to reflect this conventional view. But Marx's messeage is something quite different. He attempts to debunk the myth of the ocean as a bottomless cornucopia, and advocates that we get on with the job of properly managing the ocean's renewable resources.

In his series of essays, Marx describes the perils of overfishing and explains why we are unlikely to increase significantly the world's catch of protein from the sea. He discusses some of the promise and problems of aquaculture and the mining of ocean mineral deposits, and he explains the need to protect barrier beaches, estuaries, and wetlands. He decries the ocean dumping of sewage and hazardous wastes. Although these have been topics on the environmentalist agenda for a decade, Marx goes beyond the usual presentation by offering specific examples of how we are learning to treat the ocean less destructively. He documents the beginning of a "shift from the traditional, exploitive resource practices to those based on new, more ecologically sound perspectives. This shift is as daring and bold as Columbus's venture across the Atlantic or the descent of a scientist to the deep seabed." Evidence of this shift includes a growing interest in reclaiming sewage rather than dumping it in the ocean, and in mining the waste metals of our urban dumps rather than the manganese nodules on the sea floor.

Despite these encouraging signs, the age of exploitive thinking is far from over. The amount of waste being dumped in the ocean today is greater than ever, and immense areas of our coastal waters are being opened up for oil drilling for the first time.

As Marx writes, many people "tend to regard environmental change as a simple matter of life or death." Pollution will not kill the oceans, but it will cause deleterious changes. Many of the effects of pollution on the marine environment are subtle and difficult for the nonscientist to discern. Anyone can see an oil spill, and severe pollution may result in rows of dead fish and other animals on a beach. But sophisticated analytical equipment is re-

quired to detect low-level oil pollution or pollution from heavy metals or pesticides. For example, low-level pollution can cause large species of phytoplankton, the microscopic plants of the sea, to be replaced by smaller forms. Only a specialist with a microscope could detect such a change—the water would look no different to someone sitting on the beach. But a change from "large" (although still microscopic) diatoms to tiny microflagellates will cause other changes in the ecosystem, perhaps even the replacement of commercially valuable sunfish with gelatinous animals such as salps, ctenophores, and jellyfish.

Changes in phytoplankton composition of the sort thought to occur from pollution were observed in the North Sea during the 1970s. But are such changes actually a result of pollution, or are they due to some other human activity in that area, such as overfishing? Or are the changes completely due to natural changes in climates or currents? No one knows. But pollution may well be at least partially responsible.

We know that low-level pollution can have adverse effects on the oceans. However, we do not know how widespread they actually are. Marx writes that "some people predict the demise of this or that sea in ten or twenty years. Such predictions assume an assessment capability that simply does not exist." This point is well taken and underappreciated by most decision makers and the general public. Equally invalid, however, are the sweeping, blindly optimistic assertions of industry and some government agencies (notably the Bureau of Land Management of the Department of the Interior) that the effects of pollution are localized and of short duration.

Our present approach to pollution is a dangerous gamble. Not all change is bad, but when changes occur over large regions, and particularly when they are global, we should be very conservative. Our rush to develop offshore oil typifies our sometimes reckless attitude. Fewer than 1 million acres of U.S. coastal waters were subjected to oil development between 1940 and 1970. After the OPEC oil boycott in the early 1970s, the federal government greatly accelerated leasing of offshore areas to oil companies—to a rate of 1 million acres per year. The Reagan administration now has plans to open up 875 million acres, while research funds to assess these consequences are being cut.

Many of these new areas, if they contain oil at all, are probably marginal fields that will contribute little toward our national energy needs. Meanwhile, we are putting off necessary changes in our pattern of energy consumption. Our economy simply cannot run on oil much longer. Why not leave some of our offshore oil in the ground while we develop better technologies for safely harvesting the oil and gaining a better understanding of the potential consequences of the development and ways to minimize its effects?

Wesley Marx is essentially optimistic about the future of the oceans. He believes that we will pollute the oceans less because we will increasingly recycle sewage for its water and nutrients. The water "gained" by such recycling is a more realistic way to alleviate water shortages than desalting seawater or towing icebergs from an arctic region—yesterday's dreams. As with energy, conservation of water is the cheapest and most environmentally benign approach.

I share Marx's optimism. We will eventually adopt a more ecologically sound way of living with the oceans because we must. The sooner we do so, the more options we will have and the less painful the transition will be. But such a transition will require much thought, planning, and research. Unfortunately, the present Washington administration not only favors blind exploitation of resources and denies the potential for serious environmental harm, but it is deeply cutting funds for environmental monitoring and research.

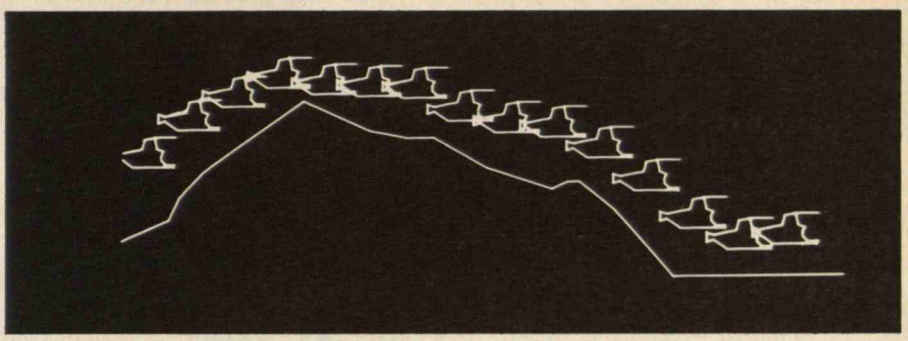
But as Joel Hedgpeth concludes in his forward to Marx's book, "Four or eight years is insignificant in the time scale of the oceans. And the problems, perhaps more acute, will still be with us. May this book serve as a guide to the rehabilitation of needed programs and a reminder of questions that demand to be asked." □

Robert Howarth is a staff ecologist at the Marine Biological Laboratory in Woods Hole. He earned his Ph.D. in biological oceanography jointly from M.I.T. and Woods Hole Oceanographic Institute.

Navigating *Alvin* Blind

Alvin, the famously successful research submarine operated by Woods Hole Oceanographic Institution, has a problem: its human pilot has very limited vision through a small window at the front of the vehicle. On bottom-crawling missions in the dark depths of the sea, the pilot often fails to see where he's going, leading to collisons with rocks and debris and forcing a slow pace extravagant of precious battery power.

An autopilot to solve these problems, putting *Alvin* in the hands of a computer instead of an oceanographer for routine navigation, has now been designed by Homayoon Kazerooni, a graduate student in the Man-Machine Laboratory in M.I.T.'s Department of Mechanical Engineering. The scheme uses two sonars—one of which sweeps the sea floor ahead of *Alvin* for hills and valleys, while the other measures the distance to whatever the first sonar has detected as a potential hazard. These inputs, processed by a computer, are used to control *Alvin*'s thrusters, moving the submersible up, down, or to the side as indicated. □



Touring the ocean bottom. This computer simulation shows the concept by Homayoon Kazerooni, an M.I.T. graduate student in mechanical engineering, for an autopilot to guide the Woods Hole Oceanographic Institution's submarine *Alvin* safely over an irregular ocean bottom. Without the autopilot, *Alvin* is controlled by an oceanographer peering through its small front window into murky depths—with collisions between the submarine and the bottom a frequent and nerve-wracking consequence.

Vented Molding

A new molding technique developed at M.I.T.—called "vented compression molding"—has been accepted by Martin Marietta Aerospace Co. to reduce the cost and time involved in applying insulation to components of the space shuttle's external fuel tanks.

The idea—a simple modification of the compression molding process—is to perforate the molding surface. The perforations allow excess material to be vented from the mold cavity. The shape, size, and location of the perforations control the pressure in the mold cavity, and this in turn determines the density of the finished part.

Saul R. Locke, productivity manager for Martin Marietta's Michoud Division in New Orleans, where the space shuttle tanks are made, says the M.I.T. development will save about $100,000 per tank. The external tank is the only major nonreusable element on the shuttle, and Martin-Marietta will make about 400 tanks for the shuttle flights scheduled through the mid-1990s.

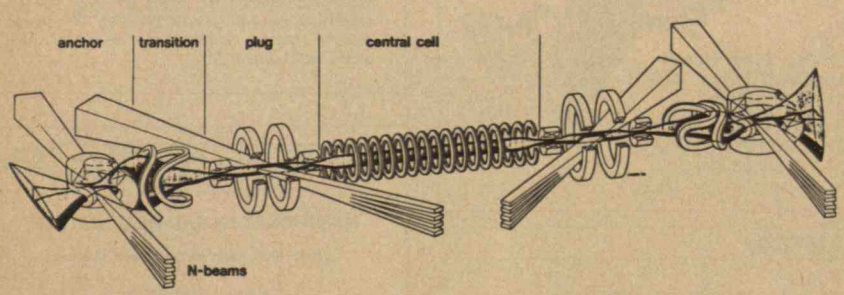
The same process can also be used in any industrial application that requires particulates to be shaped and compacted, according to Lewis Erwin, du Pont Associate Professor of Mechanical Engineering at M.I.T. □

Music for the Deaf

An electromechanical system to translate musical sounds into tactile stimuli is the goal of Adrianus Houtsma of M.I.T.'s Research Laboratory for Electronics. The purpose, he says, is to give 15,000 deaf-blind people and 2 million deaf people in the U.S. a way to enjoy music for the first time.

Conveying music's auditory richness, says Dr. Houtsma, requires transmitting such musical qualities as pitch, timbre, consonance, dissonance, and loudness. His concept is to make a literal translation of these qualities into tactile ones: loudness becomes intensity, for example, and pitch becomes frequency. An unresolved question on which Dr. Houtsma is now working: how many dimensions can be coded into one stimulus without obstructing the communication?

Dr. Houtsma's work is funded by the Council for the Arts at M.I.T. □



A new assignment for the M.I.T. Plasma Fusion Center: build and operate a major facility to study the tandem-mirror concept for confining plasmas at the level of energy required for fusion. The program, funded by the Department of Energy, will require some $13 million over the next 30 months. Richard S. Post, senior research scientist, says M.I.T.'s will be a "medium-sized device" (above) designed especially to test the advantages of axisymmetry in tandem-mirrored confinement.

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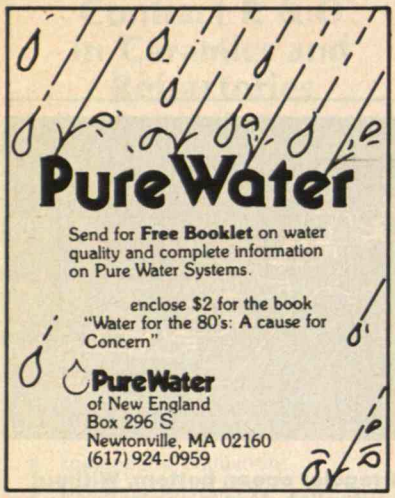

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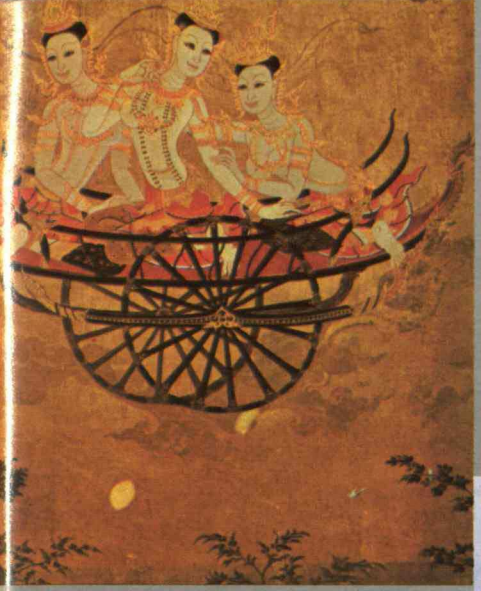

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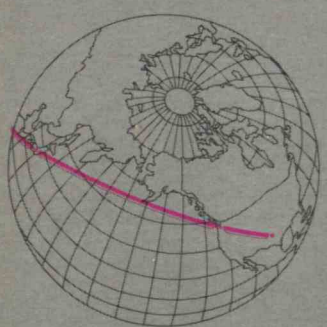

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